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PAGE

Editorial Comment 1
The Administration's views anticipated. Lightships and lighthouse tenders. Ship breaking.
Marine Engineering and Shipping Age, January, 1922.

Merchant Marine, Future of Our 3
By "Old Scotch."
Restored normal prosperity in America must be based on foreign trade. We cannot rely on others to carry our products.
Marine Engineering and Shipping Age, January, 1922.

Merchant Marine, 12 Percent Increase of America's 4
Marine Engineering and Shipping Age, January, 1922.

Subsidies, Great Britain and Her 5
By Winthrop L. Marvin
A lesson for the law makers of the United States. America's need for subsidized shipping.
Marine Engineering and Shipping Age, January, 1922.

Economics of Operating Reconditioned Liners 7
By Carl E. Petersen.
Figuring revenues at a minimum and expenditures at a maximum the *Mount Vernon* and *Agamemnon* could be operated at a profit.
Marine Engineering and Shipping Age, January, 1922

Operation of American Ships on Economical Basis .. 8
By Robert E. Annin.
Experienced ship operator outlines savings accomplished. Overhead, stevedoring, manning schedules, wages and subsistence reduced.
Marine Engineering and Shipping Age, January, 1922.

Detention of Ships in Port 10
Average number of days in berth at British ports required by vessels engaged in foreign trade.
Marine Engineering and Shipping Age, January, 1922.

Railroad Contracts with Foreign Shipping Lines ... 11
By Waldon Fawcett.
Investigation of preferential contracts between American railways and foreign shipping companies.
Marine Engineering and Shipping Age, January, 1922.

Insurance, Developments in Marine 13
By "Bolderean."
Lake underwriting experience. Deck loads. Government threat. Court decisions. Builder's risks. The *Tanamo*.
Marine Engineering and Shipping Age, January, 1922.

Electric Drive in Coast Guard Cutters 15
By Captain Q. B. Newman, U. S. C. G.
Cutter *Tampa* driven by first synchronous propelling motor. Practical advantages of synchronous motors. 18 illustrations.
Marine Engineering and Shipping Age, January, 1922.

Yacht Guinevere, Auxiliary Schooner 23
The largest fore-and-aft auxiliary schooner yacht ever built equipped with Diesel electric drive. 7 illustrations.
Marine Engineering and Shipping Age, January, 1922.

Air Port, Operating on Breech Block Principle 25
Marine Engineering and Shipping Age, January, 1922.

Rates, British Lines Cut 25
Marine Engineering and Shipping Age, January, 1922.

Shipbuilding Returns for 1921, American 27
Output of merchant tonnage three times pre-war record. Much repair work in sight. Important developments looked for in 1922.
Marine Engineering and Shipping Age, January, 1922.

Shipping and Shipbuilding in Great Britain in 1921 .. 28
By W. H. Wendon.
Schemes for improving freight situation. Shipping values. Earnings of steamship companies. Shipbuilding prospects.
Marine Engineering and Shipping Age, January, 1922.

PAGE

Motorship: The First Motor Passenger Liner 31
By A. P. Chalkley.
The *Alba*, of 8,000 tons deadweight and 14 knots speed, built for African service. 11 illustrations.
Marine Engineering and Shipping Age, January, 1922.

Dry Dock, Sun Shipbuilding Company's New 36
Forty-two ships docked during first six months of operation, averaging one vessel every 3½ days. 2 illustrations.
Marine Engineering and Shipping Age, January, 1922

Passenger Steamer Hoosier State 38
Marine Engineering and Shipping Age, January, 1922.

Ventilators, New Type of Control for 38
Marine Engineering and Shipping Age, January, 1922.

Watch for Studying Efficiency, Duration Time 39
Marine Engineering and Shipping Age, January, 1922.

Chuck, Toothed Key and Sleeve Type 39
Marine Engineering and Shipping Age, January, 1922.

Passenger Steamers, Design and Construction of ... 40
By E. H. Rigg.
Summary of problems confronting the designer of a modern liner. Details of new American passenger ships. Standardization.
Marine Engineering and Shipping Age, January, 1922.

Motorships, Shipping Board Authorizes Sale of Twenty Vessels for Conversion Into 45
Marine Engineering and Shipping Age, January, 1922.

Instability 46
By C. H. Peabody, Dr. Eng.
Conditions that may lead to instability and the consequences that may be looked for. 8 illustrations.
Marine Engineering and Shipping Age, January, 1922.

Electric Propulsion of Ships 50
By W. F. Thau.
Discussion of Diesel electric propulsion and application of electric drive on warships. 1 illustration.
Marine Engineering and Shipping Age, January, 1922.

Ericsson, Memorial Tablets for 54
Marine Engineering and Shipping Age, January, 1922.

Boring Bar, Portable Taper 54
Marine Engineering and Shipping Age, January, 1922.

Calking Materials for Shipbuilding Purposes 55
By Horace Holden Thayer.
Continuation of series of articles dealing with shipbuilding materials and their uses.
Marine Engineering and Shipping Age, January, 1922.

Shipping Policy, President Plans Definite 57
Marine Engineering and Shipping Age, January, 1922.

The Most Interesting Job in the Yard 58
By Charles I. Mason
Why the engine erector's job has a claim to the above title.
Marine Engineering and Shipping Age, January, 1922.

Panama Canal, Shipments Via 59
Marine Engineering and Shipping Age, January, 1922.

Compounding the Internal Combustion Engine 60
By Elmer A. Sperry.
Discussion of the development of the compound Diesel engine, its construction, operation and advantages. 2 illustrations.
Marine Engineering and Shipping Age, January, 1922.

Questions and Answers for Marine Engineers 64

Personal 66

Shipping and Shipbuilding News 67

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The Administration's Views Anticipated

CHAIRMAN LASKER of the Shipping Board may not always correctly reflect the views of the President, but as he prefaced his speech before the Association of Commerce at Milwaukee on December 13 with the statement that "it was my honored privilege to submit the manuscript of this address to President Harding, whose passion to see America successful on the ocean is second to none" it may be safely assumed that there is nothing in this speech that does not meet with the hearty approval of our Chief Executive.

With this in view, a comparison of Chairman Lasker's remarks relating to the "Arms Conference and the Merchant Marine" with the leading editorial in the December issue of MARINE ENGINEERING AND SHIPPING AGE, which was written over three weeks before Mr. Lasker delivered his speech, is most interesting, showing as it does an apparent endorsement of our views.

After praising the Limitations Conference "as one of the glorious jewels in the crown of American accomplishments" Mr. Lasker immediately proceeds with the following statement: "Granting that the 5-5-3 naval program, or some equivalent, be adopted and that we have a naval holiday for a term of years, the question of naval equality is not solved; because if in addition to the equalized navies any one nation possesses a merchant marine of convertible strength vastly beyond that of another nation, the nation possessing that added convertible merchant tonnage has the preponderance of naval power."

Compare the above with our December editorial which starts as follows: "We are in full accord with the principle of the limitation of armaments and the cessation of the mad race for naval supremacy in "capital ships" which in the end can only mean financial ruin for the nations involved. But as great sea battles were fought in the days of ancient Rome with wooden vessels propelled by oars, so could terrible conflicts be waged today with the giant ocean liners hastily equipped with aerial, chemical and submarine instruments of warfare too numerous to mention. America must not forget that the importance of England's and Japan's great fleets of ocean liners will increase in far greater than direct proportion to the number of warships scrapped."

Chairman Lasker, although depreciating the possibility of a war between this country and Great Britain, gave comparative figures showing the relative superiority of the British merchant marine for convertible purposes. He said, "taking into consideration passenger and cargo ships of 8,000 tons and over which represent the very cream of the merchant marine convertible for naval purposes, Great Britain possesses 234 ships of this type already completed and the United States possesses 54 ships, a ratio of 4.3 to 1 in favor of Great Britain. Taking into consideration vessels of this type now actually building in both countries, the ratio in favor of Great Britain will be increased to 5 to 1."

MARINE ENGINEERING AND SHIPPING AGE has repeatedly advocated the reconditioning of the ex-German liners and the construction of new passenger ships. We do not expect war but we do know that it is easier to respect a nation that is an equal in strength than one that is comparatively impotent. It will be a wonder indeed if everything goes along smoothly in the future and this country having no axes to grind, no territory that it wishes to acquire, will be lax in its duty to the world if it suffers its naval strength to fall to any such standard as 1 to 5. We must rank somewhere near as equal in strength in our convertible merchant marine to other countries in order that our passion for peace may not be jeopardized.

But that is not all, for there are at least thirteen good and sufficient commercial reasons why we should balance our fleet unless we intend to scrap our cargo ships. No one denies that the freight rates are now too low to offer a sufficient inducement for capital to invest in shipping but, on the other

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hand, there has been no reduction in first class passenger fares. It is safe to say that the *Olympic* has been netting over two hundred thousand dollars a round trip up to November and that the *George Washington* on one trip, at least, gave a profit of $100,000. The naval architect of one of our steamship lines shows on page 7 of this issue what could be done with the *Agamemnon* and *Mount Vernon*, if they were properly reconditioned. Wake up America! for what is done during the coming year will probably determine whether or not "Old Glory" shall take its proper place on the "seven seas."

Lightships and Lighthouse Tenders

SECRETARY HOOVER in his annual report emphasizes the immediate need for an appropriation for the construction of sixteen new lightships and eleven lighthouse tenders. As it takes from two to three years to get these vessels into commission after an appropriation is made, the urgency of prompt action on this matter cannot be too strongly advocated.

The report gives us the astounding information that twelve of the lightships are over fifty years old and that the average age at the present time of the lighthouse tenders is twenty-one years and the light vessels thirty years. There are now in active use nineteen lighthouse tenders that are over twenty-five years old and twenty-three lightships that are over thirty years old. Of course this deplorable condition is largely due to the concentration on merchant work during the war but, aside from this, there has been a large increase, amounting to 40 percent, in the number of aids to navigation that have to be maintained.

There can be no question of the necessity and importance of the work that the Lighthouse Service is doing in safeguarding both life and property. The loss of one ocean liner through a breakdown in this service would more than offset in property value, to say nothing of the loss of lives, the entire cost of the twenty-seven vessels that are urgently needed. Sooner or later such a catastrophe is bound to occur, if we continue to rely on these antique ships to perform the extra hazardous duty and to navigate in the shoal waters that this service requires.

That this department of the government has continued to function efficiently in the face of such a handicap in equipment must be credited to a splendid personnel, and it is therefore all the more shameful to require the officers and crews to continue to risk their lives in these old vessels which navigate in waters that every other ship takes good care to avoid.

However, from a practical business point of view there is no advantage in retaining in service any vessel after it has reached a reasonable limit of usefulness. There is a greatly diminished output of work and a rapidly increasing cost of upkeep and operation. The cost of repairs and the continual overhauling are sufficient reasons to construct new vessels, but when we have added to this the fact that the shipyards are anxious and willing to build these vessels at much lower prices than it has been possible to obtain for years, or are likely to occur again, there is nothing to be gained by waiting for a serious accident to stir us into action.

Ship Breaking

ONE of the immediate results of the Disarmament Conference will be the starting of a new industry in this country which in England is called ship breaking. It is estimated that there are between 400,000 and 500,000 tons of warships that must be scrapped and the problem is to salvage the material, machinery and equipment contained in these vessels. If this can be done successfully, there are millions of tons of obsolete and inefficient merchant ships which must, sooner or later, either be scrapped or taken out on the ocean and sunk.

However, without reference to the merchant vessels and relating solely to specific warships, a conference under the auspices of the Navy Department was held at the League Island Navy Yard, Philadelphia, on December 10. Representatives from shipyards, steel companies, scrap dealers, financial organizations, the Navy Department and trade papers attended. It was hoped that the conference would bring out a discussion of the national importance of the problem and the desirability of establishing ship breaking concerns in this country but no one volunteered any information of a nature that gave any light on the financial possibilities of the business.

Mr. J. G. Hitner of Philadelphia did say that he had been engaged in this line of work for several years and had been successful at it. He recommended that the Navy Department should require a high enough deposit from the bidders to eliminate all but reliable concerns and that it would not be fair for a company to submit the amount that it was willing to pay for a ship and thus expose its hand unless the highest bid was accepted whether or not it fell below what the Navy Department considered the ship was worth.

Representatives from companies which produce gas for cutting stated that there would be no trouble in cutting through armor but did not give any figures upon which estimates could be made. The whole meeting gave one the impression that while everyone was interested nobody had any intention of giving any information that could be of possible use to a competitor.

The presence, however, of shipyard representatives suggested possibilities for the utilization of plants where the equipment used in erecting a ship might also be used efficiently to break it up. Shipyards located in districts where transportation of the salvaged material to the market would not be too high should, with the equipment at their command, be in a far better position to handle this work than a dealer in scrap metals.

The question is, are the ships to be stripped of their brass fittings and such equipment as may be easily removed and then towed out to sea and sunk or are they to be salvaged to the greatest possible extent, even to cutting them to pieces with the gas flame? There are several thousand tons of structural steel in a ship of ordinary size. Is it possible for a yard with the proper equipment to break up this material cheaply enough to make it profitable as a business proposition? If it is, then we should not overlook the possibilities of the ship breaking industry, for there are millions of tons of vessels afloat today which should be broken up.

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The Future of Our Merchant Marine

Restored Normal Prosperity in America Must Be Based on Foreign Trade and We Can Not Rely on Others to Carry Our Products

By "Old Scotch"

OUR ocean shipping, our shipbuilding and all our allied interests are in a very critical position. Never before in our history have these industries, so vital to our national well-being, faced such a dark outlook as at present.

Those requirements for the Jones law, which are supposed to be ample to protect our foreign shipping from the relentless rivalry of other nations, are not to be enforced. The reasons given by our executive for his failure to enforce these sections intended to establish our merchant marine permanently are evidently sufficient to his mind to warrant his declining to act, although it is strange, according to his own statement, that the much dreaded retaliation has not been even hinted at officially by any of the interested nations. Possibly it is due to causes with which it is not advisable to acquaint the public. Hence relying on his already demonstrated intensely patriotic interest in our merchant marine, it will avail naught to carry the inquiry further. What, then, awaits us? What hopes have we who with abiding faith have looked confidently to the future renaissance of our merchant marine?

A Straight Subsidy

In an article appearing in this magazine one year ago, the writer then expressed himself that after all is said and done the one sure remedy for our shipping ills is a straight-out subsidy, or, as Chairman Lasker recently expressed it in a public utterance, "a subsidy without synonym."

The President has already stated that early in January he will make a special appeal to Congress for a sufficient subsidy to enable private owners to operate our ships in the open rivalry on the seas. It is entirely unnecessary to try and convince the readers of this magazine of the national benefit of a subsidy to our ships in the foreign trade. Every one connected either directly or indirectly with shipbuilding or ship operating knows full well that it must come to pass, else our hopes and ambitions on the seas will perish ignobly. It is therefore the duty of each and all of us, who are thus interested, to constitute himself as a merchant marine evangelist and by every means possible and at every opportunity to preach the doctrine of governmental aid to those who are ignorant of the benefits of a nation's shipping to the general well being of all. In the offices, the shops, the railroads, the clubs and in the highways and byways, wherever you find a citizen and a voter needing enlightenment on this all-absorbing topic, go at him with an array of facts and arguments, so that he too will become enlightened and interested. The campaign must be intensive and far reaching. Do not overlook anyone; the further they live from the seacoasts, the more intensive should be your efforts.

President to Recommend Method

The executive has promised that he will endeavor to recommend a method whereby the money necessary to carry out his ideas will not be taken directly from the pockets of the already sorely tried taxpayer. Let us hope that the methods recommended will be such, as we know from past history of similar endeavors that anything which savors of governmental help to any particular industry will have a rocky road to fruition. The average congressman or senator looks askance at any such proposal and it is only the pressure from their constituents which will gain their support. It is well, therefore, for those of us who are interested to rehearse and fortify our arguments, which we know full well are logical and just.

In the writer's opinion the whole subject should be approached on the broad lines that a subsidy is another form of a protective tariff, no more and no less. In a new country such as ours, possessed by divine grace of enormous natural resources in field, forest and mine, it was but natural that in our early days we devoted ourselves to agricultural and mining pursuits and received our manufactured goods from the lands of our forebears, where, through the centuries of their development, such branches of industry had become thoroughly and efficiently established.

As our nation grew, and huge centers of population developed, many of our citizens began to look for a livelihood to sources other than those of the established elementary vocations. Whatever your politics may be, you must admit, as history has proven, that the great manufacturing interests which we now possess have been made possible by adopting the principles of the protective tariff in the earlier stages of development. The pioneers in any branch of manufacturing were confronted by lack of experience and by the higher standards of living which had, owing to our great national resources, become fixed in our customs. Almost any of the long list of goods, which our factories and mills now produce so successfully, would have been impossible of production here if the pioneers had been compelled to produce them in open competition with the long established plants in Europe. The 3,000 miles of water which intervened was in itself a barrier directly in proportion to the fluctuating costs of ocean freights, but that in itself was by no means sufficient.

Hence, in many instances protective tariffs ofttimes as high as 40 to 50 percent were established to aid these infant industries. As they gradually developed, and American skill and enterprise were applied to the methods of manufacture, many of the most important of them have reached a position whereby it is possible to produce the goods at home, without the necessity for any tariff to protect them. Notably among these is the great steel industry, developed from nothing until today we manufacture more of that highly essential product than all the other nations of the world combined.

Our Foreign Shipping an Infant Industry

Our shipping in the foreign trade today is an infant industry, exposed to the most intense rivalry of other nations, strongly entrenched by many years of experience and having much lower standards of living with consequent lower costs of operation. It does not even have the benefit of the protection of 3,000 miles and more of water surrounding our continent, for just one league from our shores the ships of all the world have an equality of opportunity. Basically and naturally, therefore, our shipping in its present early state of development must have the benefit of governmental protection, as all our other great manufacturing industries have had. A subsidy to ships is the indirect and only way of effectively applying the principle of a protective tariff on the seas.

Why is it necessary to have our own ships, and why not let foreigners, who specialize in sea-carrying and can do it for

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less than ourselves, have the business, asks the unthinking?

The same inquiry could have been, and probably was, made concerning the steel industry, the tin-plate industry, the clothing industry or in fact any of our industries other than agricultural or mining pursuits.

The answer to any of these questions might be: Very well, if we all want to be and can be miners, farmers or lumbermen let foreigners do all of these things.

But we have reached a state in our national development where our manufacturing output exceeds our agricultural output. Further, we are producing much more manufactured products and farm products than we consume among ourselves. No business is successful unless it sells all its output. If Henry Ford manufactured 1,000,000 of his justly famous "flivvers" every year, and could only sell 850,000 of them and annually had 150,000 left on his hands, he would soon be a bankrupt and would not be figuring on buying railroads and nitrate plants.

In other words, we have to export our surplus products, amounting to 15 percent of our output in factory, farm and mine to be successful as a nation. To prevent our "flivvering" as a nation, these surplus products must be transported over the water and sold to other nations. Many of these other nations have excess products of the same kinds which they too must sell across the waters and what is more, they have their own ships in which to carry them.

Foreign Ships Will Give Preference to Their Own Products

Now, let us presume that our generous rivals will be glad to carry our goods to these same markets, where they wish to sell their own products in competition. You can have one guess, as that is all that is necessary, as to whose goods will be sold first. Just now, in this period of depression, if some magnate in Madagascar or other outlying place should even indicate that he wanted to buy ten locomotives, or a 1,000 tons of wheat, he would be deluged with offers. If we had no ships of our own, who do you imagine would get these orders?

It is all very well for foreigners to cut rates for carrying our goods overseas, when they know we have our own ships in which to make deliveries, but suppose again we had no ships of our own, what do you suppose the rates would then be, when it came to competitive selling overseas?

Merchant Marine a National Asset

A good, large merchant marine with all that goes with it would be a national asset, even if all our vessels were tied up to wharves or at anchor in our own ports in readiness to be operated. It would be worth millions of the public funds to protect us in our endeavor to dispose of our surplusage.

Having ships of our own is like having money in the bank. If a man has a good bank account, he can borrow funds very readily, but if he goes broke, no one will even look at him when he needs more funds.

Fifty years ago our foreign rivals had to have our food and minerals, but they do not have to buy our manufactured products and our farm products today, unless we make it attractive to them to buy from us. Hence every citizen of this country is either directly or indirectly interested in the maintenance of our own delivery system, exemplified by our sea-going merchant ships.

Now, how can this necessary subsidy be paid without further crimping the taxpayer's pocket? The answer seems simple enough.

During the late war and immediately following it, we spent about three and a half billions of dollars to create an enormous fleet of ships as a necessity of the times. In the minds of the public that sum has been marked off, along with the billions spent for battleships, ammunition, pay of soldiers and salaries and other sacrifices to the demon war. We were drunk and now we are going through the morning after.

Sell the Ships with a Subsidy

We could not sell these merchant ships today for much more than a half billion dollars, if that much, because under existing conditions it is not profitable for private owners to operate them under the American flag. If Congress grants a subsidy of say $50,000,000 as a protective tariff to our shipping industry, the sale value of the fleet would be doubled. Therefore sell the ships and out of the money obtained (already charged off in the minds of the public) pay the subsidy.

At first glance it looks like a bootstrap proposition, but think it over; the more you think about it, the better it will look to you. Keep also in mind the steel industry in this country, and of how by American methods it has progressed in a comparatively short time to a position where it no longer has to be coddled.

No shipping, no shipyards, is axiomatic. Therefore it behooves us all in either of these industries to get busy with our arguments for this subsidy legislation. We must succeed, or else we had better begin to study agriculture, and I know that shipping men make poor farmers.

Twelve Percent Increase of America's Merchant Marine Reported by Commissioner of Navigation

THE annual report of the Commissioner of Navigation shows that on June 30, 1921, the American merchant marine comprised 28,012 vessels of all kinds of 18,282,136 gross tons, an increase over the preceding fiscal year of 1,958,114 gross tons, or 12 percent.

Of this amount 5,951 vessels of 11,077,398 gross tons were in the foreign trade, 21,478 vessels of 7,163,136 gross tons were in the coasting trade, and 583 vessels of 41,602 gross tons in the fisheries. The tonnage of vessels registered for the foreign trade is almost eleven times larger than in 1914.

There were 1,361 vessels of 2,265,115 gross tons built, 380 vessels of 183,209 gross tons lost and 212 vessels of 116,572 gross tons sold to alien flags during the year.

It is interesting to note that the average gross tonnage of a merchant vessel in 1868 was 154, in 1920 it was 579, and in 1921 it was 652.

The number of officers, below the grade of master, and seamen shipped and reshipped on American vessels by shipping commissioners was 325,832, of which 48.3 percent was American. The total number shipped, reshipped and discharged by shipping commissioners and collectors of customs was 707,206.

The use of radio on American vessels has increased rapidly since 1914, when there were 555 vessels equipped, compared with 2,978 in 1921, an increase of 437 percent.

The total number of radio stations of all kinds, with the exception of amateur receiving stations which are not required to be licensed, was 10,355 in 1920 and 12,258 in 1921.

Steamboat Inspection Service Activities.—During the fiscal year ended June 30, 1921, the Steamboat Inspection Service inspected and certificated 8,095 vessels with a total gross tonnage of 16,231,001, of which 7,753 were domestic vessels with a total gross tonnage of 13,139,630, and 342 were foreign passenger steam vessels with a total gross tonnage of 3,091,971. Of the domestic vessels, there were 6,437 steam vessels, 716 motor vessels, 15 passenger barges, and 585 seagoing barges.

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Great Britain and Her Subsidies

A Lesson for the Law Makers of the United States—America's Need for Subsidized Shipping

By Winthrop L. Marvin

ONLY in the United States are shipping subsidies ever debated. Elsewhere they are accepted as a matter of course. A dozen years ago $47,000,000 was being annually expended by the nations on the fostering of their merchant marines. Now the sum is unquestionably greater. The imperative need of merchant ships and seamen has been a thought indelibly burned into human consciousness by the great world war.

Of this $47,000,000 expended for shipping subsidies by the nations of the world in 1909 and the years immediately thereafter, about $1,000,000 in a few postal contracts was the contribution of the United States. The richest of all countries was giving less to its merchant marine in this way than Canada ($1,581,000), one-third as much as Spain ($3,150,000), less than one-third as much as Italy ($3,872,000), and less than one-fifth as much as Japan ($5,413,000). France was then paying $13,423,000 a year in subsidies and Great Britain and her colonies nearly $10,000,000. It is Great Britain that has made the first and most successful use of shipping subsidies—and that notwithstanding their obvious conflict with her contemporaneous policy of free trade, now being quietly abandoned.

Cunard Line Created by Postal Bounty

British ocean subsidizing dates back more than eighty years to the postal bounty of $425,000 a year, which in 1839 created the Cunard line of transatlantic steamers. There quickly followed other and larger subsidies to the Peninsular and Oriental, the Royal Mail, the Pacific Steam Navigation Company and other new services to all quarters of the world. These early British subsidies did more than merely to create and sustain steamship communication. They contributed powerfully to the aid and development of steamship building and engine building in the era when the art was new. These subsidies were paid to liners when all steamships were liners, but after a while the shipyards which the subsidies had fostered were launching "tramps"—for it is the unfailing experience with liner subsidies that they develop commerce, which soon demands slower and cheaper cargo vessels for the carrying of its cheaper and bulkier cargoes.

Great Britain never made a more profitable investment than her several hundred million dollars of steamship subsidies from 1839 to 1921. These subsidies put behind the Cunard and other British steamship services of that kind the entire power of the Imperial government and made British steam shipping the most effectively protected industry in existence.

The Early British Subsidies

It is well for Americans, facing the same problem that confronted their kinsmen so many years ago, to take some note of the character and purpose of those earlier British subsidies. These are clearly and authoritatively stated by the Parliamentary Committee on Ocean Mail Contracts, through which British subsidies were first extended. Those lawgivers of 1840-1850, who framed the contracts and perfectly understood their nature, declared:

"The objects which have led to the formation of these contracts and to the large expenditures involved were to afford us rapid, frequent and punctual communication with distant ports which feed the main arteries of British commerce and with the most important of our foreign possessions, to foster maritime enterprise and to encourage the production of a superior class of vessels which would promote the commerce and wealth of the nation in time of peace and assist in defending its shores against hostile aggression."

Merely substituting "American" for "British," President Harding might well cite these words of the Parliamentary Committee defining the character and purpose of British subsidies as the preamble of his shipping bill of 1921!

In 1909, and in the other years just before the world war began, British postal and admiralty subsidies to steam lines, retainers to naval reserve officers and men and similar assistance to merchant shipping amounted to a very substantial encouragement to shipbuilding and navigation. "In effect the Admiralty contracts," declared the report* of the British Tariff Commission in 1909, "constitute a rigid system of protection," particularly "to the British engineering and shipbuilding industry." And again, quoting from this same authoritative report, "Engineering and shipbuilding derive other considerable advantages from Government subsidies and Government mail transport and other contracts given to various British shipping lines. During the past ten years the government money which has passed into the hands of British steamship companies in respect of these and similar services has amounted to nearly £2,000,000 per annum."

It was with the historic facts about British steamship subsidies in mind that Mr. Blaine, in his celebrated debate over free trade and protection with Mr. Gladstone, declared:

"It will not escape Mr. Gladstone's keen observation that British interests in navigation flourish with less rivalry and have increased in greater proportion than any other of the great interests of the United Kingdom. I ask his candid admission that it is the one interest which England has protected steadily and determinedly, regardless of consistency and regardless of expense. Nor will Mr. Gladstone fail to note that navigation is the weakest of the great interests in the United States, because it is the one which the National Government has consistently refused to protect!"

Mr. Gladstone never made any effort to reply to this—he could not answer. As one of his own contemporary public men, Henniker Heaton, Postmaster General of Great Britain, said:

"As American ships were not subsidized, their owners could not compete with the Cunard and other companies, the art of shipbuilding languished, and the American carrying trade was transferred to foreign bottoms. In 1891 only 13 percent of the exports from the United States were carried in American ships, which at one time had engrossed 90 percent."

All this is historically true and accurate—and strikingly true and just also is the further declaration of the British Postmaster General that:

"As a consequence of refusing $5,000,000 a year in subsidies during thirty years to native shipowners, or $150,000,000, the United States had to pay in the same period not less than $3,000,000,000 for freights, while their mercantile marine dwindled into insignificance."

American Subsidized Ships Led Their Competitors

So long as British subsidy was matched by American subsidy on the North Atlantic, the advantage was overwhelmingly in favor of the Stars and Stripes. Though the British had started with the first Cunard steamers in 1839, the granting of mail subsidies to the Collins and other American lines wrought an immediate and great increase in American steam shipping. As Lindsay, the historian of

*Volume 4, Paragraphs 91, 92.

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British shipping, said, "Before the American line was established, the Cunard steamers were receiving £7 10s. per ton, freight, which was so much a monoply rate that in two years after the Collins Line had commenced the rate of freight fell to £4 per ton." Moreover, the American liners, with their larger size, higher speed and more comfortable service, quickly won the best passenger trade away from the Cunarders, to such an extent that between January and November of 1852 the American ships on the route between New York and Liverpool conveyed 4,306 cabin passengers to the 2,969 of the Cunard Line. In vain the British government increased the Cunard subsidy from $425,000 to $856,000 a year. The American ships kept steadily ahead, holding all the Atlantic records and commanding the best and most profitable patronage. American ocean steam shipping rose from 5,631 tons in 1847 to 115,045 tons in 1855. As Dr. David A. Wells, the economist and historian, said:

"During the single year 1849-50 we increased our ocean steam tonnage one hundred and thirteen percent, and the seagoing qualities and performances of our vessels were so admirable that the Cunard Company, which had then been in operation ten years, was obliged to bring out new ships to compete with them. The prospect, therefore, at one time was that the United States, although late in the start in this new department of foreign shipping, would soon equal, if not overtake, her great commercial competitor."

American shipping subsidies, in other words, had proved far more effective and successful than British shipping subsidies while the two nations competed on approximately even terms. Two of the Collins steamers were lost because of the hazards of the sea. Several British transatlantic liners were also lost in the same period, the *President* and the *City of Glasgow* vanishing with all on board.

Withdrawal of Subsidies Killed the American Merchant Marine

But what killed the American transatlantic service, before the Civil War, was the withdrawal of the American subsidies in 1856 and in 1858 in the very crisis of the contest between the American and British flags. This action by Congress was due to the bitter animosities of the sectional quarrel preceding the Civil War. But for that ill-starred feud, which cost America so heavily, the Stars and Stripes would have continued to dominate the North Atlantic trade in steam as it long had under canvas.

Great Britain persisted in her subsidizing; the United States did not. That is the entire explanation, just as Postmaster General Heaton has described it, or, to quote the words of a great American shipowner and merchant, an eye-witness of the tragic change—A. A. Low, Esq., of New York, the father of Seth Low, once Mayor of New York and President of Columbia University:

"I only know the English have always, in peace and war, manifested a determination to hold the supremacy on the ocean, and the supremacy which they acquired by arms in war they have in peace acquired by subsidies. They have deliberately and intentionally driven the Americans from the ocean by paying subsidies which they knew our Congress would not pay. I believe it has been the deliberate purpose on the part of England to maintain her supremacy upon the ocean by paying larger subsidies than any other nation, as long as subsidies were necessary to preserve their control. . . . They have driven us from the ocean by that policy just as effectually as they ever did drive an enemy from the ocean by their guns."

History repeated itself in 1903, when, alarmed by the actual fact of German competition and a prospect of American competition also, the British Government gave to the Cunard Company an extraordinary grant of a subsidy of $1,100,000 for twenty years, coupled with a loan of $13,000,000 at 2¾ percent interest which virtually made a present to the Cunard Line of the giant steamers *Mauretania* and *Lusitania*. This was at once the most liberal and the most valuable and effective subsidy ever given in the history of commerce. It was worth to the Cunard Company far more than its cash value—for it involved a declaration to the world that Great Britain would stand by her shipping lines, sustain them and see them through any crisis of competition whatsoever. Since that time the Cunard Company, gathering in other organizations, has become the chief of all British steamship companies—to all intents and purposes the British government afloat.

British Shipping Backed by the British Empire

It may be urged that it has not been the British policy to give subsidies or bounties to ordinary cargo steamers. But cargo steamers and liners have been in effect protected by the world-wide knowledge that the whole resources of the British Empire were at the call of the mercantile marine, and by the complete world-wide organization of British shipowners, agents, brokers, merchants and bankers, which provides a certain preference for British merchant ships, whether they be "tramps" or liners, in all the waters of the globe.

Neither America nor any other rival has any right to quarrel with British policies toward British shipping. They reflect prudence, patriotism and common sense. British statesmen have never been troubled by any little thing like dread of inconsistency. They have had free trade for manufacturing because they believed that it was to their advantage to have it. They have maintained protection through subsidy and in other ways for shipping because they knew that it best served their interests. They are heartily to be commended for so doing—and America will be commended if she has the wisdom and courage to follow the British example in administering vigorous protection wherever it is needed for the promotion of the United States merchant marine.

Subsidy for American Vessels Urgently Needed

America needs subsidy not only for her liners but for her cargo ships, because the most of the war-built tonnage of the Shipping Board consists of cargo ships pure and simple. As conditions now are, with the whole world over-steamered, these American cargo ships cannot be put into service and kept in service in competitive overseas trade unless, like the liners, they are also sustained by the protection of the Government of the United States. Cargo ships under our flag must have this protection because, assuming even the wisest amendment of the La Follette seamen's law, they must have compensation for their higher wage and living standards and costs of maintenance.

These higher costs are not due in any great degree to navigation laws and requirements—though so far as possible these navigation laws and regulations must be changed and modernized. These higher costs of American ship wages and maintenance existed long years before the enactment of the La Follette law. They would exist if that law were totally abolished. They are fundamentally due to the higher wages and standards of living that prevail among American workers on land, by which, and not by statutory law, sea wages and standards of living are established. There are the same reasons for protecting American cargo ships as there are for protecting American factories and farms—and the cogency of these reasons is not seriously questioned at any time by any considerable proportion of the American people.

Moreover, America is a country of heavy export cargoes. Its staple products of agriculture, mine and forest are relatively bulky materials. They demand and justify particularly the very active encouragement of cargo ships to convey them to the markets of the world.

With these conditions in mind there is no justification for withholding from our shipping the same protection that has given life and prosperity to our other industries.

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Economics of Operating Reconditioned Liners

Figuring Revenues at a Minimum and Expenditures at a Maximum, the Mount Vernon and Agamemnon Could Be Operated at a Profit

By Carl E. Petersen

ONE hears so much nowadays concerning our inadequate representation in the North Atlantic passenger service coupled with the fact that a number of large ex-German liners are laid up at their docks after strenuous war service with no apparent definite policy as to their reconditioning and with few prospective buyers that it is thought that an estimate of the possible economics of two of these vessels, the *Mount Vernon* and the *Agamemnon,* would be interesting and a subject of profitable discussion.

These vessels, formerly the *Kronprinzessin Cecile* and *Kaiser Wilhelm II,* were for a time the largest and fastest passenger vessels in the transatlantic service and they had the reputation of being very profitable to their owners. Of course, it is realized that economic conditions with respect to steamship operation have changed greatly since pre-war times.

Particulars

Length over all	706 feet 6 inches
Length between perpendiculars	680 feet 4 inches
Breadth	72 feet 0 inches
Depth	44 feet 2 inches
Gross tonnage	19,503
Net tonnage	6,589
Mean draft	31 feet 6 inches
Average speed at sea, knots	22 4
Mean indicated horsepower	43,000

Service

For the purpose of these notes it is assumed that the vessels will be used to maintain a high speed transatlantic passenger, mail and express cargo service between New York and Bremen via Plymouth and Cherbourg.

Fuel

While these vessels at present use coal for fuel it is well recognized that in vessels of this size, type and power the additional operating expense, principally due to the larger fire room personnel required, delays in coaling, together with a loss in passenger space, would preclude the use of coal for fuel from an economic viewpoint. The use of oil as fuel would also increase the revenue from mails and express cargo and it would have the advantage of cleanliness. Therefore, the conversion from coal to oil is included in the total estimated cost of reconditioning.

To maintain an average speed of 22 knots and allowing 1.1 pounds of oil per indicated horsepower hour the fuel consumption per day would be 510 tons or not quite one ton per mile. Figuring the voyage one way at 3,900 nautical miles and allowing six lay days in port at 40 tons per day it will be seen that 4,140 tons of fuel are required. This capacity can be obtained in these vessels in the arrangement which at one time was contemplated. Fuel oil delivered is figured at $15 per ton or about 30 percent higher than the prevailing price at New York to allow for the higher price in Europe.

Passengers

Passenger revenue is based on a 75 percent capacity of 680 first class, 330 second class and 620 third class figured at minimum rates of each class, viz., $275 and $250 for first class high and low seasons, respectively, and $140 for second class and $103 for the third. When it is considered that previous to the war the demand for passage on these vessels exceeded the accommodations during the high season by 33 percent and equalled 75 percent of the capacity during the low season, the percentage used for an estimate is moderate. With excellent accommodations for all classes, equal or superior to competitive vessels, actual rates will exceed the minimum ones. No revenues from bar sales, steamer chair hire, confectionery, etc., are included in this estimate.

All figures are based on 12 round trips per year maintaining a 28-day schedule with one month lay up during the winter for annual overhaul. This schedule will allow more than ample time in port and by reducing the stay in port 13 round trips per year could easily be made should it be desired.

Subsistence is figured at $2 each per diem for first class passengers, $1.50 each per diem for second class, and $1 each per diem for third class and crew.

Express Cargo and Mail

	Tons
Weight of ship light	20,000
Water in boilers	800
Fuel oil	4,140
Fresh and feed water	1,600
Passengers, crew and stores	415
Mail, 6,000 sacks at 50 pounds each	135
Express cargo	600
Displacement at 31 feet 6 inches mean draft	27,680

Express cargo is figured at a nominal figure of $10 per ton per trip. The actual revenue will be largely increased because it is customary to rate express cargo by the measurement ton and the cubic is available in these vessels. However, the figure given will suffice for an estimate.

Mail carried without special contract is usually conveyed eastbound at a rate of 80 cents a pound for letters and post cards and 8 cents a pound for other matter and westbound at about 35 cents and 4½ cents respectively. For the purpose of this estimate mail is figured roughly at $5 per sack eastbound and $2 per sack westbound, allowing 6,000 sacks eastbound and 1,000 sacks westbound.

Annual Revenue per Vessel

Passengers		
1st class 680—75%—@ $275 x 13 one way trips	$1,823,500	
1st class 680—75%—@ 250 x 11 one way trips	1,402,500	
2d class 330—75%—@ 140 x 24 one way trips	831,500	
3d class 620—75%—@ 103 x 24 one way trips	1,149,500	
	$5,207,000	$5,207,000
Mail		
6,000 sacks @ $5 x 13 one way trips	$ 390,000	
1,000 sacks @ 2 x 11 one way trips	22,000	
	$ 412,000	412,000
Express Cargo		
600 tons @ $10 x 24 one way trips	$ 144,000	144,000
Gross revenue		$5,763,000

Annual Expenditures per Vessel

Fuel—99,600 tons oil @ $15	$1,494,000	
Wages, officers and crew	453,500	
Feeding passengers and crew	512,500	
Equipment, water, lubrication and stores	165,000	
Repairs	240,000	
Insurance	90,000	
Rental of terminals, stevedoring and handling, port charges, towage, advertising, administractive, and sundries	980,000	
Total expenditures		$3,935,000

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CAPITAL EXPENDITURES

	S. S. Agamemnon Built 1902	S. S. Mount Vernon Built 1906
Purchase price "as is"	$ 800,000	$1,100,000
Cost to recondition	2,200,000	2,000,000
Capital invested	$3,000,000	$3,100,000
Depreciation	600,000	344,000
Interest on investment, 6 percent	180,000	186,000
Capital charges	$ 780,000	$ 530,000
Gross revenue	$5,763,000	$5,763,000
Gross expenditures and capital charges	4,715,000	4,465,000
Balance after deducting expenditure and capital charges	$1,048,000	$1,298,000

DEPRECIATION

Depreciation is charged off in this estimate at a flat rate of 20 percent and 11.1 percent yearly for the *Agamemnon* and *Mount Vernon*, respectively, for the reason that the prudent steamship owner would no doubt have the invested capital written off by the time the vessels are 25 years old.

In this way rising costs of operation due to age could be offset by the absence of capital charges and the vessels show a profit for some years to come.

INTEREST

Interest on the investment is taken at 6 percent per annum on the decreasing book value of the capital invested.

CONCLUSION

Revenues are estimated at a minimum, expenditures at a maximum and reasonable factors and values are used throughout. From the estimated balance it will be seen that the reconditioning and profitable operation of these vessels is not a hopeless proposition. The fact that passenger fares have remained at the peak while freight rates have scraped the bottom shows that the supply is not greater than the demand as far as passenger ships are concerned. It would seem that a million dollar profit per annum on an investment of $3,000,000 in the most stable department of ship operation would attract the attention of even the conservative element of the investing public.

American Ships Now Operating on Economical Basis

Experienced Ship Operator Outlines Savings Already Accomplished—Overhead, Stevedoring, Manning Schedules, Wages and Subsistence Reduced

By Robert E. Annin

WHETHER freights have reached bottom at present or whether they are destined to go still lower may be a matter of opinion. Surface indications point to at least the *relative* maintenance of the present level of rates, i. e., that freights can only decline further, if, and when, a decline in the level of operating costs shall have become established. The progressive and worldwide laying up of tonnage clearly indicates that (at least under present cost scales) the operating dead-line has been reached.

American operation has been the most expensive in the world, due to causes which have been thoroughly exploited and which it is not necessary to detail here. Some of these causes still persist and are likely to do so for some time. Others have been due to the inflated psychology of the years 1915 to 1920. This has affected all nations greatly; but has had, perhaps, a particularly marked effect here, owing to the greater proportion of new operators and the almost unlimited demands of American labor during the war emergency. A certain American impatience of small economies may also have been a special factor in our operating costs. In ship operation this latter factor would chiefly affect the inexperienced, since trained operators of every nation know the imperative need of the closest economies in every department of their business. In close competitive times there is no such thing as an "unimportant" economy.

Among the larger expenses of war time, the item of swelled salaries ashore was notable. When freights were at their peak, for instance, salaries of $10,000, $15,000 or $20,000 were not uncommonly paid by concerns which were operating only small squadrons; and every old organization found its personnel constantly threatened by the bidding of new "operators" for their most promising young men. All this, of course, reacted upon the whole salary level for department heads and managers; making the shore end of operation here enormously higher than abroad.

For minor positions (assistants, clerks, etc.), our level has always been much above the European; and this class of office workers profited largely by the inflation of the war and afterwards. Chiefly for these reasons, new and small organizations here frequently ran office expense schedules up to $100,000 or more per year—a scale of expense unknown in this class of firm abroad, even in the times of highest freights.

SHORE EXPENSES OF ENGLISH SHIPPING FIRM

In this connection, the yearly statement of an English shipowning company for the year 1920 seems quite pertinent and affords a striking contrast to the shore operation of many war-time concerns on this side.

The corporation in question showed capital and reserve of £700,000 and assets of about £1,050,000; indicating (on the basis of ruling values even at the end of 1920) a very modest fleet. The gross operating earnings were £145,000; a not surprising figure when the freights ruling in the early part of the year are considered. The main items against earnings were repairs and general maintenance of steamers, about £37,500; and an income tax of £39,000. But the most striking items in the statement are the following:

"To business expenses, including management and rent	£3,076/12/4
"Directors' fees	991/ 0/3
	£4,067/12/7

or say $16,000 shore expense for the management of $4,000,000 of shipping property—4/10 of one percent for shore management and under three percent of gross earnings for management and rent, including directors' fees. In the year 1920 it is a safe assertion that few firms of the same class in America were getting through on less than three times these figures. Of course the extravagant shore expense of the boom times is now a thing of the past. The high rents and salaries and the general disregard of economy, here and abroad, have stopped.

It was obvious from the first that, when the inevitable collapse should occur, such a condition would be the first to cure itself. The failure of some firms, the voluntary re-

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tirement of others and the inevitable cutting down of office force by the remainder have already reduced salaries to something like a pre-war basis for all except absolutely essential men. This process is likely to continue until the men displaced by lack of business have had time to disperse into other occupations. The times when it was necessary to offer $12,000 to secure a $4,000 traffic man seem very far in the past, yet this was approximately the case a little over two years ago.

This has been the first great American economy introduced since the slump; it has come very close to being universally practiced, from stenographers to managers. It is not necessary to speak of partners and proprietors who find themselves living on their own savings, or in vulgar phrase, "sucking their paws."

In normal times the shipping business pays high salaries to only a very small proportion of office personnel; certainly not a larger proportion than other trades. Clerical aid earns no more money in shipping than a similar quality of service commands elsewhere. But during the boom freights the pay of every branch of service, afloat and ashore, showed an inflation that was simply staggering to oldtimers, trained in the economies of 1901-1910. Here, then, is one recent disadvantage of American operation that is rapidly lessening by mere force of economic pressure. The result is inevitably a very material reduction in the per ton cost of handling tonnage from the shore end. That is to say, the reduction of exaggerated salaries means an increased efficiency per unit of expense.

LOADING AND DISCHARGING COSTS REDUCED 50 PERCENT

One might speak here of a similar improvement in conditions "along the beach," as relates to loading, discharging and wharf work. These were almost incredible at one time and certainly cast a valuable direct light upon the contention that high wages produce efficient service. Those whose duties called them to the wharves when wages were at the highest usually came away confirmed in the old conservative belief that such a contention merely confused cause and effect. Since the arrival of hard times, however, "the beach" has gone a long way back toward normal. With the decline in wages and increase of unemployment has come an increase of efficiency which has reduced loading and discharging costs by certainly over 50 percent. To the average man, the fear of losing his job is the only sure incentive to diligence and efficiency. This, however, so far as it concerns either American or foreign ports, applies to all ships equally and is therefore no *relative* gain as between rivals.

Turning to the marine department of operation, operators have been working most keenly, consistently and intelligently to reduce the admitted handicaps under which American ships have heretofore labored. Owing to causes generally recognized, ships privately owned have some advantages over those handled through Government agencies. It is therefore from the private owners that the most marked progress should be expected in important (and even vital) operating economies.

During the boom freights, and owing to the scarcity of efficient men in all ratings, the American ships carried a larger personnel than any rival except the Japanese. Our wage scale was also much higher. Hence, on the face of things, the American expense for wages and subsistence was enormously higher than that of foreign competitors, amounting at times to nearly double that of the English and Norwegians on vessels of the same class. In this result the depreciation of foreign currencies was the chief factor. A German ship (for instance) was reported arriving at Philadelphia last August, with the master drawing a wage of only 2,000 marks a month—then equal to $25.

The effect of this condition, added to others, was such that the American had either to retire from the competition (at least temporarily) or find some way by which his payroll might bear a reasonable relation to that of his chief rivals.

TEMPORARY WITHDRAWAL OF AMERICAN SHIPS

So far as the occasional business is concerned (i. e., tramp charters), it is evident that most American owners, including the Emergency Fleet Corporation, chose the first course. This is a fair inference from the fact that a leading freight broker's report (from September 1 to December 1, 1921) shows from American ports about 471 outward charters, of which only about 30 were American. (These figures are not necessarily exact but are sufficiently so for any use which is here made of them.) This is for business out of North American ports, excluding United States coastwise trade, which is, of course, protected.

Now, considering that a large part of tramps arriving here come in ballast *"seeking"* (for our deep-sea trade has never been a balanced one) it is clear that, if we can only retain six or seven percent of our business when our foreign rivals bear the waste of coming to us, we cannot hope for success, if we bear the waste of going to them, as for instance in attempting to compete for the export trade in English coal.

It seems therefore a fair statement, based on these facts and considerations, that the record of the past few months indicates the temporary withdrawal of American tonnage from the "full cargo" market.

There remain, however, the line services, private and Governmental (established, unestablished, and incubating), which cannot in the nature of the business withdraw and re-enter as conditions fluctuate. It is among these that we should look for the results of continuous consistent effort in operating economies aboard ship; and it is there, in fact, that we find the greatest progress in such direction.

Of these economies, in view of the inflated conditions from which we are now emerging, the payroll is among the most important. So far as higher ratings are concerned, every line operator strives to retain those licensed officers who have made good, knowing from experience that to keep changing this class of employees for the sake of any small immediate saving is one of the greatest of extravagances. Like every other human aggregation, licensed officers have their share of incompetents and worse. One of the tramp owners' great difficulties is the constant drift of the best officers toward the steadier and more permanent liner services. On the other hand, the line managements, by a continuous process of selection, have the opportunity to build up a personnel which may constitute a most valuable asset; and in pursuit of this purpose the line agent will avoid any policy which would, in the end, prejudice this result.

SELECTION OF EFFICIENT OFFICERS

Under such circumstances no attempt to economize by laying off able officers is likely to result in permanent saving. But the process of selection is made more severe, the incompetent and careless more sternly weeded out and the efficiency thus reached, both on deck and in the engine room, constitutes in itself a most important and permanent economy. No longer need the owner put up with masters who are resourceless at sea and in port, or careless or unsatisfactory in the log books or accounts. The engineer who notoriously spends, personally, more money than he earns officially, and whose fuel accounts are inconsistent and suspicious, is remorselessly replaced by one who has not these eccentricities of genius. In this sense the surplus supply of licensed officers offers a great opportunity for the best and most permanent kind of economy, i. e., the selective upbuilding of an efficient personnel.

In the lower ratings, however, there is opportunity for direct economy both in numbers and pay. The average mer-

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chant crew is partly composed of a restless and migratory class whose steadiness cannot be counted on from one voyage to the next, whose avocation is change of berth and whose chief outdoor sport is desertion. So far as this class is concerned no sacrifice of immediate economy to insure permanence is warranted except in the case of individuals.

As to wages, the excess supply of seamen has already greatly reduced payrolls from even last year's level. With bread and butter necessities staring them in the face, many sailors in the lower ratings will accept, and are now accepting, wages which would be very close to the English scale if sterling were at par. Reports of $60, $50 and even $40 berths accepted, for instance, by able seamen are not uncommon. In fact the market is a wide open one and the owner or agent may make what bargain he can with individual seamen. Even the needy trade unionist realizes that half a loaf is better than no bread in these times. So much for the wage situation, per se.

Manning Schedules

Further economies are now being practiced in the cutting down of personnel. An American ship which a year ago carried twelve able and ordinary seamen may now, perhaps, get along with eight; some which in 1920 had ten men and boys in the steward's department will now operate with six. The main difficulty a year ago, when labor was scarce, was that the men would not stand for extra work. Today they will. The saving of wages and subsistence for four seamen in the deck department and two messmen and one utility man in the steward's department may not have sounded very important during the high freight period, but in these days $400 per month in wages and subsistence from such an economy looks quite worth while.

In the engine room the cutting down of force is more difficult, partly because of the attempt to make the engine room force "100 percent American." In an open competition any limiting condition applied to one competitor and not to another is a handicap in reaching the nearest to ideal efficiency. It is *not* for nothing that the thrifty and economical Scot has a world wide reputation as a marine engineer. In the engine room, accounts show the greatest relative economies in personnel, stores, lubricants and, above all, bunkers.

Nevertheless, some of the most up-to-date operators now claim that as to number of personnel they can about match the English crew list on the average, i. e., so far as numbers go they are at no material disadvantage; where they were, only a year since, pulled down by wages and subsistence for five to nine extra men.

Economy in Port

Payroll economy may also be practiced in port whenever outward cargo is not in sight for an arriving ship. In such case the deck and steward's departments can be cut down to a caretaker's basis in the lower ratings. Reduction can sometimes be made in the engine room, but not always, and of course not to the same extent, the engines always requiring more attention, care and tuning up than any other part of the ship.

But deck and engine officers, recognizing the difficult situation of owners under present conditions, will often make special arrangements during a waiting period which materially reduces their pay while in port; a sort of "loss-sharing," which, however, is purely for an emergency. Such arrangement may be presumed to be confined to officers who feel secure of their positions and who, therefore, submit to a sacrifice of personal interest out of loyalty to their line. A sacrifice of this kind is likely to give them a special status for the future. In other words, such action, like most human action, may result from motives more or less mixed.

The matter of subsistence has necessarily received strict attention with marked effect. There is some difference between Kipling's mate of a Cardiff collier who would "eat clinker to save waste" and the post bellum table of a merchant foremast hand which ran into all sorts of excesses from broiling poultry to fruit out of season. The subsistence bills of merchant ships during the war and post-war boom were appalling even to the most inexperienced operators. The causes were partly war inflation, partly inexperienced operators and partly graft.

Cost of Subsistence

In 1913 an English owner expected to feed his crew at from 35 to 40 cents per day per man. In the winter of 1920-1921 the average cost on English ships ran up to $1 per head and of American $1.25, $1.50 and (as is reported in some cases) very much higher. From thence on there has been a steady decline in cost of subsistence on all ships and, as the American was most extravagant in this respect, the decline in American cost has been notably the greatest. From a per capita of at least $1.25 less than a year since, the price had reached $1 by June, 1921; 85 cents by August, and may now fairly be placed at an average of 60 cents. Reported present costs range from 65 cents down to 52 cents per capita, according to circumstances.

Detention of Ships in Port

FIGURES giving the average number of days spent in berth and the average number of days waiting berth by vessels engaged in foreign trade for certain of the large ports in Great Britain are published monthly by the British Board of Trade. From these reports are taken the figures tabulated below which refer to vessels dealt with at the accommodation of the Port Authority named.

By "working day" is meant a complete week day of 24 hours, Sundays and holidays being excluded and parts of a day being dropped. No distinction is made between a vessel which carries cargo only one way and one which both discharges and loads, nor as to the character of the cargo handled. It will be apparent from this that the figures are not comparable as between one port and another, but that within certain limits they are comparable between one month and another at individual ports.

Port and Name of Authority	Month 1921	Number of Ships Departing	Average working days in Port per ship	Average delay per ship waiting berth Days
		Total	Days	Days
London	July	316	9.04	0.25
(Port of London Authority)	June	289	9.05	0.32
Liverpool	July	299	6.27	0.00
(Mersey Docks & Harbour Board)	June	268	5.80	0.00
Cardiff	July	92	1.76	....
(Cardiff Railway Co.)	June	4	1.00	....
Newcastle	July	63	1.60	0.03
(Tyne Ports) (River Tyne Cmrs.)	June	9	2.67	0.67
Glasgow	July	57	6.04	....
(Clyde Nav. Trustees)	June	50	6.32	....
Hull	July	90	4.71	0.03
(H. & B. Rly & Hull Jt. Dk. Committee)	June	65	4.54	....
Newport	July	65	1.40	0.06
(Alexandra Docks & Railway Co.)	June	2	3.50	....
Swansea	July	30	1.50	0.07
(Swansea Harbour Trust)	June	20	1.65	0.05
Manchester	July	94	5.07	0.06
(Manchester Ship Canal Co.)	June	79	4.80	....
Bristol	July	61	5.44	1.15
(Corporation)	June	51	5.61	....

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Railroad Contracts With Foreign Shipping Lines

By Waldon Fawcett

The exclusive or preferential contract between any railroad operating in the United States and any foreign flag shipping company is soon to become a relic of the past. This much may be confidently predicted as the result of a conference held at the offices of the United States Shipping Board in Washington, the first week in December. This conference between the representatives of ten leading American railroads and the Shipping Board Committee on Interstate Commerce Conferences, was the fruit of a spirit of resentment that has lately manifested itself in the Congress of the United States.

THAT element in the national legislature which has given unreservedly of its enthusiasm in behalf of the upbuilding of an American merchant marine was manifestly perturbed, not long since, when it came to the attention of Congress that there were in existence close compacts. or exclusive contracts, for reciprocity in the exchange of traffic between certain American railroad systems and various shipping companies operating vessels of foreign registry. There was animated discussion in the United States Senate as to the propriety of such entangling alliances, and ultimately the Senate "resolved," as it does when a matter of public policy or practice requires investigation.

All that will be necessary, however, to abolish existing international alliances of rail and water transportation interests and to prevent such arrangements in future is repressive action by the Shipping Board. By the terms of the Jones law, or the Merchant Marine Act of 1920, the Shipping Board is clothed with ample authority summarily to sunder the foreign connections of American railroads and this fact is fully appreciated by railroad executives. Indeed, some of the railroad men, moved by the spirit of patriotism or seeing the handwriting on the wall, had already taken steps to terminate existing contracts ere they journeyed to Washington to discuss the situation with the Shipping Board committee consisting of Frederick I. Thompson, of Alabama, chairman; E. C. Plummer, of Maine, and Meyer Lissner, of California.

Conference Has Dual Purpose

Dual purpose was ascribed to the conference. First, the Shipping Board commissioners would examine, by means of first-hand information, into the extent, character and effect of the railroad contracts with foreign shipping corporations. Unless, however, evidence of exceptional character was forthcoming the outcome was foreordained. The Shipping Board committee had devoted weeks of preliminary study to the subject and out of a close inspection of copies of all the contracts and the personal experiences and observations of the three commissioners had been borne a pretty strong conviction that, sentimentally and practically, the existence of such contracts was detrimental to the best interests and the future prospects of the new American merchant marine.

Second of the purposes of the conference was formally to ask of the railroad interests the abrogation or cancellation of these contracts that seem to bid defiance to an expanding merchant marine under the United States flag. It was this phase of the objective that necessarily rendered inconclusive the immediate outcome of the negotiations. There was manifest on the part of some of the railroad men a spirit of ready concurrence in the ideas and the wishes of the Shipping Board committee and on the part of the other railroad delegates the realization that the word of the Shipping Board is law in the premises. But a number of the railroad executives asked for time to consult with their directorates or fellow executives—not so much as to the fundamental act of renunciation as to ways and means of severing relations legally—and accordingly the conference adjourned to await the preparation of formal proposals on the part of the railroads. However, as has been said, whether the process be wholly voluntary or partly compulsory, the outcome is almost inevitable.

Exclusive Contracts Affect Development of Ports

Incidentally it was revealed in the course of the hearings that the Shipping Board committee which initiated the impending "reform" has in prospect a project of even deeper and more intimate significance to the shipping interests of the United States than the severance of foreign alliances. Chairman Thompson dropped the remark that, once this present problem is out of the way, the committee contemplates an investigation of all existing contracts and reciprocal arrangements between American railroads and American shipping interests. He was careful to make it clear that this impending issue is not to be allowed to becloud the current one but seemingly there is a suspicion that anything in the nature of exclusive contractual relations between rail and water lines may not only make impress upon the evolution of the merchant marine but might likewise exert influence upon the development of American ports and the provision of terminal facilities.

Ten American railroads are involved in the international "communities of interest" which the Shipping Board is so strongly inclined to regard as prejudicial to the free fighting chance of an American merchant marine. As shown by the records compiled by the Shipping Board committee the contract distribution covers both hemispheres. The Baltimore and Ohio Railroad has contracts with the Donaldson Lines, Scandinavian Lines and Furness, Withy and Company. It formerly had a contract with the North German Lloyd but this lapsed when the German service to the port of Baltimore was interrupted at the time of the world war. The Great Northern Railway has a contract with Nippon Yusen Kaisha—a contract that provoked the most spirited discussions of the conference owing to the fact that it was renewed in October, 1921, on the very eve, as it were, of the governmental move to bring about severance of relations.

The Pennsylvania Railroad has contracts with the International Mercantile Marine Company and the Pennsylvania's affiliated line, the Northern Central Railroad, has engagements with the International Mercantile Marine and Furness, Withy and Company. The Southern Railway Company and the Mobile and Ohio Railroad each have contracts with the Mobile Liners, Inc. The Boston & Albany Railroad is accredited with contracts with the Leland Steamship Lines and Cunard Steamship Company. The Chicago, Milwaukee and St. Paul Railway is affiliated with Osaka Shosen Kaisha. The Grand Trunk Railway System has pooled interests with the White Star Dominion Line and the Atlanta, Birmingham and Atlantic Railway has a compact with the Strachem Shipping Company.

Some Contracts Are not Harmful

For the most part these various commitments are ten-year contracts, with option of renewal. Most of them may be

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cancelled upon six months' notice by either party or upon shorter notice by mutual consent. Before the Shipping Board committee went below the surface in its investigation, it was assumed that all the contracts were approximately on a par, insofar as effect upon American merchant marine interests might be concerned. It developed at the hearing, however, that there is a wide disparity in intent and influence. Some of the contracts seemingly offer no practical menace whatever to the American merchant marine. For example, the contracts of the Pennsylvania Railroad and the Northern Central with the International Mercantile Marine Company merely relate to the use of specific piers owned by the roads, a use not discriminatory against other shipping. Then again there is the case of the Grand Trunk contract with the White Star Dominion Line. It was brought out that the only purpose of this compact was to secure for the port of Portland, Me., during the winter months, traffic that is almost wholly of Canadian origin. It was predicted that the only effect of a rigid repressive policy in this quarter, at the behest of the Shipping Board, would be to drive traffic to Canadian ports with no compensatory advantage to either American ports or the American merchant marine.

Pursuing the subject, it might be added that one of the outstanding features of the Washington conference was the warning by railroad executives that the Shipping Board must, in its zeal to preempt the field for the American merchant marine, proceed cautiously lest it drive to Canadian ports transatlantic and transpacific traffic that the United States ports can ill afford to lose. This was the plaint in particular of W. P. Kenney, vice-president and director of traffic of the Great Northern Railway—an executive whose viewpoint was the more interesting because he was formerly the head of the Great Northern Steamship Company. Indeed, Mr. Kenney remarked at one point that the Great Northern has expended to date more money than has the United States Shipping Board to keep the American flag on the Pacific.

Danger of Diverting Cargo to Foreign Ports

Defending his company's contract with the Nippon Yusen Kaisha and its renewal in the face of the Government's concentration on the upbuilding of an American merchant marine, Mr. Kenney stressed the danger that Japanese ships be diverted to Canadian ports and Japanese cargoes be routed via Canadian transcontinental railroads to destinations in the eastern part of the United States. The Great Northern executive, reacting to the patriotic plea, took a fling at the numerous shippers in the United States who are routing their Oriental shipments via the Canadian Pacific to the coast and thence via Canadian ships to the Far East. And he had something to say regarding the Dollar line of steamers which, upon passage of the La Follette Act, sought a Canadian port and alien registry and which, Mr. Kenney declared, now gets more tonnage from the United States than does any American line on the same route.

Throughout the discussion the traffic director of the Great Northern maintained that he had renewed his contract with the Japanese line so recently as October, 1921, simply because he felt that, if there was in the compact anything antagonistic to American public policy, the Shipping Board had ample authority to nullify the agreement. It was difficult, however, for the Shipping Board commissioners to sympathize with this viewpoint. Chairman Thompson said earnestly that he felt that the principle was inescapable that the Great Northern had, by this contract renewal, gone into direct competition with the Government in its effort to establish a merchant marine, at the very moment when the Government thought that it had assurance of the cooperation of all agencies. The commissioners felt especially aggrieved that the Great Northern had not even conferred with the Government before renewing its contract, albeit the Government has on the Pacific a service comparable with the Japanese and is planning to place five fast steamers in the Seattle service, even though it be necessary to operate these at a loss as the ships on this route have been operated at a loss in the recent past.

Cannot Influence Shippers Beyond Their Own Lines

With varying degrees of emphasis the railroad executives who demurred at cancellations of their contracts with foreign shipping interests pivoted their justification on one outstanding radical premise. This theory was that American railroads benefit individually from foreign shipping contracts by allocation of incoming tonnage but, because of a lack of ability to dictate as to the disposition of outbound tonnage, are unable to do any harm to American shipping. It was a bald assumption that the contracts are in distribution of benefits, decidedly one-sided, or that the American railroad has, as one spokesman put it, "the long end of it."

To support such a theory requires, of course, a daring logic. The railroad men had it ready to hand in the contention that, under present conditions, an American railroad —no matter how keen it may be to throw business to an affiliated shipping interest (American or foreign)—is unable to influence shippers as to routes or carriers beyond its own lines, save in rare instances. Control has been taken from the railroads in the routing of this overseas business according to this school of thought. In proof of it, Traffic Director Kenney of the Great Northern Railway pointed out how his road's Japanese shipping ally was first chagrined and then incensed at the inability of the Great Northern to turn over its traffic bound beyond the Pacific and how finally the Nippon Yusen Kaisha, facing the inevitable, had been compelled to build up its own freight soliciting organization in the United States until today the Japanese line has in New York, Chicago and other traffic centers larger organizations than the Great Northern itself maintains.

Relation of Inbound and Outbound Traffic

That theory which assumes that the railroads are able to secure, through the intervention of foreign shipping interests, a worthwhile aggregate of inbound tonnage without repaying in kind was only equalled in interest in the presentation at the conference by the plea that American railroads are capable of maintaining alliances with foreign shipping lines without giving to the latter any special concessions or any treatment preferential in any way to that vouchsafed to all other lines, including, of course, the American flag lines with which there are no such special contractual relations. The leading exponent of this theory at the conference was Mr. Archibald Fries, vice-president in charge of traffic, Baltimore and Ohio Railroad. The Baltimore and Ohio executive insisted that the contracts of his line with British and Scandinavian shipping companies, as above enumerated, do not beget for these connections any service or privileges not given to more than a score of other lines (American and foreign) that dock at the Locust Point piers of the Baltimore and Ohio.

It was explained by the Shipping Board commissioners that the objectionable element in contracts such as have been entered into by the Baltimore and Ohio with foreign lines lies in the grant of free use of piers and in the promise on the part of the railroad company to use its "best endeavors" to promote the business of the affiliated line. This precipitated quite a discussion as to the precise meaning of the term "best endeavors" but the representative of the Baltimore & Ohio insisted that both his principals and the foreign shipping companies and their agents understood that the contracts assumed that there was to be no discrimination for or against any line. In answer to a question as to how, in the face of the "best endeavors" clause, the Baltimore & Ohio

(*Concluded on page 22.*)

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Developments in Marine Insurance

Lake Underwriting Experience—Deck Loads—Government Threat—Court Decisions—Builder's Risks—The Tanamo

By "Bordereaux"

NAVIGATION on the Great Lakes has closed for another season, and in the opinion of underwriters it has been a period of unusual experiences. The world-wide slump in shipping has been felt very keenly on the Lakes; October and November, in particular, were two of the very dullest months in freight ever on record in that region. During the entire season the movement in ore, which comprises one of the two largest commodities shipped over the Lakes, was extremely dull, due to slack business in the steel and copper industries. Up to November 1 only 22,087,786 tons of ore had been shipped eastbound over the Lakes, as compared with 50,951,942 tons for a like period of 1920. Ordinarily there is a rush of shipments as the close of the season approaches, but this year the offerings were far below those of previous years. Grain, on the other hand, moved in considerable volume throughout the year and was rushed forward in numerous ship loads as the final day of navigation drew near. Total shipments for the season exceeded 200,000,000 bushels, which is an increase over the movement of this commodity in 1920 by close to forty percent. The reason lies in the low price of grain, creating a large demand from abroad; but a late sharp decline in the foreign demand resulted in a glut of grain at Atlantic ports and the resultant employment as storage warehouses of vessels laid up for the winter. The charge for insurance on values so stored is about two-thirds of a cent per $100 per day—a practice that has been in active vogue for years, the lake marine policy carrying a regular winter storage clause to this effect.

The usual exciting scenes were again enacted at Lake ports as the hour for the close of navigation approached. Twenty steamers were rushed out of Fort William, Ont., in twelve hours, carrying more than $7,000,000 worth of grain. The last vessel to get away and take advantage of the lower insurance rates beat the clock by the narrow margin of only fifteen minutes.

Navigation on the Great Lakes, by the insurance schedule, covers about two hundred and fifty days, the actual period depending upon ice conditions during April and December. In an open season navigation often continues as late as December 20, but as the lighthouses and other aids to navigation are not in operation after the sixteenth of the latter month, vessels find it difficult to procure insurance for sailings from the head of the Lakes after the twelfth. Hull policies permit of navigation up to December 1 at the policy rate, with additional sailings granted up to December 12 at heavily increased quotations subsequent to the first.

On the whole, hull insurance experience on the Lakes has been favorable throughout the season; but cargo premiums have fallen off. Low water during the last few weeks of the season was responsible for numerous strandings, and after the severe storm in early November the water level at the lower end of Lake Erie became so low that many groundings occurred and vessels drawing more than fourteen feet were not allowed to enter the Welland Canal. It is expected that next year will see a return to almost normal activity on the Lakes, as many of the vessels that during the war were brought down to the Atlantic coast have returned in answer to the demand of the grain movement for boats that can pass through the Welland Canal to Montreal and to the sea.

Regulating Deck Loads

SHIPOWNERS and operators will find much to interest them in the model rules proposed in the Hague Rules, 1921, designed to guard against the disastrous consequences of excessive deck loads. Insurers are conscious of the enhanced hazards involved in stowing five percent or more of a cargo above the weather deck, and they are convinced that the carriers know of the added dangers but take chances for the sake of more freight. Several resolutions were devised by the conferees at the Hague, covering the point, and they are urging their several Governments to give them legislative support to the end that there may be a decrease in shipping casualties caused primarily by the overloading of decks. Following are the Hague resolutions:

(1) That all ships which carry deck cargoes exceeding 5 percent of their total deadweight capacity should have a certificate indicating their fitness to carry such deck cargoes.

(2) That a uniform system of issuing certificates of fitness should be adopted by the various maritime States.

(3) That, with a view to arriving, if possible, at a uniform system in the various maritime States, it should be submitted to international expert opinion to decide whether, in addition to the above requirements, a uniform system of fixing a special load line and for absolute regulations restricting height and weight of deck cargoes would be desirable.

(4) That, in any case, the British regulations with regard to light woods can be modified with advantage.

(5) That the Maritime Law Committee take such steps as may be required to induce the Governments of the various maritime countries to arrive at an international understanding on the lines above mentioned.

Government Investigation Threatened

CONSIDERABLE excitement has been created among marine underwriters of late by intimations from Washington that the Government is seriously considering engaging in cargo insurance on account of the alleged discrimination made by underwriters against Shipping Board boats. The Washington authorities insist that shippers making use of Board vessels are charged a substantially heavier rate than is asked for regular liners and that this increases the overhead to an extent that militates seriously against the upbuilding of our merchant marine. This has been specifically denied by the marine insurance men. They point out that insurance is a science and that in the making of rates due consideration is necessary for such elements as past records of steamship lines and the experience of those operating them.

It would be a gross injustice to operators of lines that have shown a favorable record through a long term of years to charge them an added rate in order to offset losses likely to arise at the hands of less capable operators. However, the latest authoritative information from Washington is to the effect that the Shipping Board commissioners have finally abandoned the idea of putting the Government into the business and now propose to limit their activity as regards marine insurance to a thorough investigation. "We propose," says Commissioner Meyer Lissner, "to make a thorough scientific investigation and not to jump to any hasty conclusions."

Doubtless the reason for not carrying out the original

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threat has three angles. The Jones Act does not grant authority for the Government to go into the business; no appropriations committee would grant the large sums necessary; and the country is in no temper to support the idea of more Government in business. The Shipping Board has named a commission to study the marine insurance situation, and Commissioner Lissner is at its head. One of its first efforts, so it is stated, will be to obtain the co-operation of underwriters in naming rates equal to those on privately owned tonnage.

The Burning of the "Tanamo"

A NUMBER of interrogations were received by the underwriters after the sinking of the steamer *Tanamo* with its cargo in New York harbor. Those interested in risks of this character were anxious to learn how nearly their insurance policies covered them. It appears that a fire raged in the hold of the ship during a considerable part of the trip from Porto Rico to New York and the only way it could be controlled was to open the seacocks and permit the vessel to fill. The fire damage is, of course, a particular average; the damage done by the sinking will be made good in general average. Even though it is shown that the fire was of incendiary origin, as is suspected, the liability of the underwriters will not be reduced, as fire and its consequences are covered unless the fire be occasioned by an agency specially excluded from the policy; and this is not the case with ordinary incendiarism.

Encouragement From the Courts

TWO court decisions have recently been most favorably received by the marine underwriters. One was the fine of $250 imposed on the *Santa Tecla* by Judge Learned Hand of the United States District Court of New York for violating the regulations with regard to polluting the waters of the harbor by the discharge of waste oil. The offense was committed at Pier 33, South Brooklyn, nearly a year ago, and the circumstances were an attendant permitted a tank to overflow while the vessel was receiving her supply of fuel oil. The campaign against polluting harbor waters by oil discharge has been actively backed by marine insurance interests, and by fire men as well, largely because of the extreme danger to shipping and harbor property occasioned by floating oil. Federal legislation along this line is under consideration at this time by the Rivers and Harbors Committee of the House. It is believed that regulations will be devised for the control of this perilous practice and that in them will be included an arrangement for disposing of oil waste at our chief ports by means of adequate plants that will pay for the oil and carry it off to be burned after the valuable by-products have been extracted.

The second piece of court encouragement came from the Federal District Court at Norfolk, Va., which returned indictments charging the owner and three members of the crew of the *Charles G. Endicott* with conspiracy to scuttle the ship and also with actually casting away a vessel at sea. The *Endicott* was an American schooner. She sank last February off the Cuban coast while carrying a cargo of coal and her ten survivors told an identical tale of collision with a floating mine. She was insured in the New York and London markets for $181,000 on war risk coverage and $176,000 on straight marine. The actual value of the ship was figured at about $100,000, even at a time when values were very high; the remainder fell under the head of charter property insurance. Some of the insurance was paid, but the foreign underwriters instituted inquiries that have finally resulted in the action taken by the Federal court at Norfolk. In this connection it is interesting to recall that a statute still survives that makes the crime of barratry punishable with death; the offense charged against those held responsible for the sinking of the ship, however, is of a statutory nature other than barratry.

Builder's Risks on Equitable Basis

BEFORE the commencement of shipbuilding on such a large scale in the United States all builder's risks, whether of steel or wooden construction, were covered under a form known as the "Institute Clauses for Builder's Risk." The worst feature of this form was a clause which gave the builders permission to increase the value from time to time, and also provided that in the event of a loss the sum insured should be regarded as the insured value. When the American Hull Builder's Risk Committee took up the task of drawing up a new builder's risk form, one which would be equitable to both assured and assurer, they immediately changed this clause. The value of the vessel insured was to be at all times the completed contract price of the vessel, and the whole amount was to be insured from the date of laying of the keel.

The reason for this clause is: Where insurance is placed in installments the average liability under a policy is increased. The larger number of installments the more nearly the average liability approaches the full amount of the policy, making the real the same as the apparent rate; the real rate being the actual rate on the liability assumed, and the apparent rate being the rate at which the policy is written. Therefore one result of insuring on the installment plan, and indeed the underlying reason why assured and brokers always favor the installment plan, is to reduce the rate which had already been agreed upon as the proper one.

Valuing the property—that is, the vessel insured—at the amount of valid insurance in force at any given time is extremely objectionable, because a company never would know just what proportion of any loss it would be called upon to pay, or its ratio of liability.

Rating Shipping Board Vessels

MARINE insurers are wondering how the Shipping Board commissioners can reconcile the clamor for lower rates on their boats with the announcement of Chairman Lasker that of fourteen hundred steel vessels owned by the Board one-third are useless for ordinary commerce and another one-third are but moderately suitable. Coming on top of Commissioner Lissner's declaration that Shipping Board vessels are just as good as any other vessels and entitled to as low an insurance rate as the best, this would indicate a considerable divergency of opinion. It is reported that the A. G. W. I. Lines have turned back their lake-built boats to the Shipping Board on the ground that they could not be operated profitably. These boats were constructed for coastwise trade and, if steamship lines engaged in coastwise service can not operate such vessels profitably, they might, it would appear, as well be scrapped now as to be maintained in idleness for several years before the scrapping takes place. Underwriters are wondering whether Commissioner Lissner is of opinion that they should be operated transatlantic at approved liner insurance rates.

Gothenburg Dry Dock Built in Germany

In a description of the new dry dock at Gothenburg, published on page 445 of our June, 1921, issue, it was stated that this dry dock was built by the owners, the Eriksbergs Mek. Verkstads Aktiebolag, Gothenburg. Since the publication of this article we have been informed that the dock was built for the above company by the Brückenbau Flender Aktiengesellschaft, Benrath and Lübeck, Germany, from designs by Mr. von Klitzing of Hamburg.

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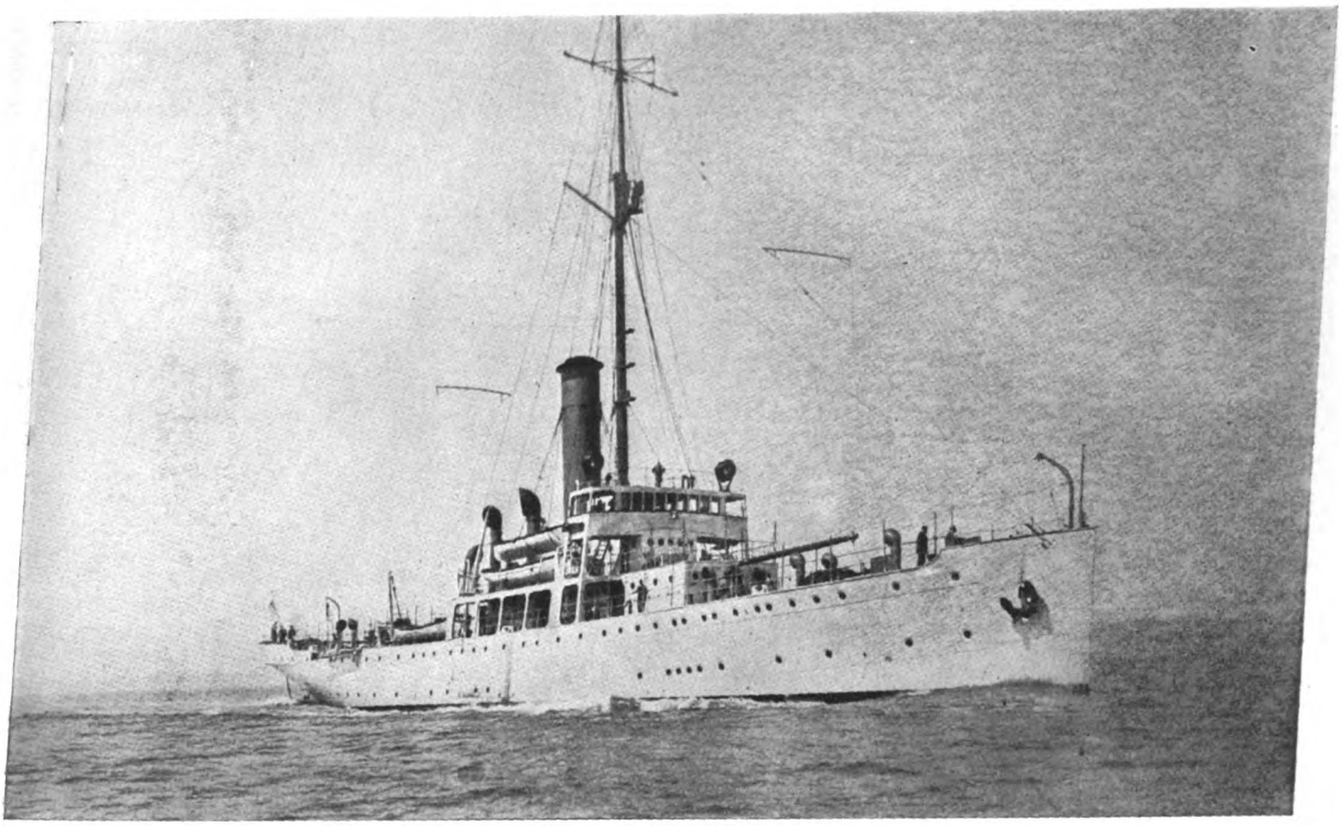

U. S. S. Tampa, the First of the New Electrically Driven Coast Guard Cutters

Electric Drive Applied to Coast Guard Cutters

Cutter Tampa Driven by First Synchronous Motor Built for Marine Propulsion—Practical Advantages of Synchronous Motor

By Captain Q. B. Newman, U. S. C. G.*

IN discussing types of propelling machinery for ships, the points usually considered in the order of relative importance are reliability, efficiency, durability, weight, space occupied and cost to construct and install. For many years the machine which answered the requirements more fully than any other was the faithful old reciprocating steam engine with its multiple expansions.

The Revenue Cutter Service, forbear of the present Coast Guard, had an honorable part in its development and took a pardonable pride in its achievements. There is scarcely an American text book on marine engineering which fails to include somewhere the classic experiments on the *Rush, Gallatin, Dexter* and *Dallas* to determine the effects of steam jackets, the benefits of compounding and the merits of small bore and long stroke as compared to large bore and short stroke.

One day a ruthless scientific person pointed out that the multiple expansion engine is not sufficiently expansive and that, inasmuch as half of the original energy of the steam is still in it at atmospheric pressure, we should travel down the vacuum line till it begins to touch bottom, if we would have real efficiency. Someone else suggested that superheated steam would catch a lot of heat that formerly went up the stack, and the days of the reciprocating marine engine began to close. For, although the low pressure cylinder had been divided into two, it was still too restricted and superheat was bad for cylinder lubrication and for high pressure rods.

At the head of the list of Coast Guard requirements is responsiveness. You can back up on a lee shore till there is only a foot of water under the keel, if you are absolutely sure there is instantaneous power at the other end of the telegraph, but you cannot do it with confidence if you must wait half a minute or a minute while a turbine gathers way. And so the Coast Guard was forced to adhere to the reciprocating engine for a long time after it began to lose caste elsewhere, because it was the only machine which had this quality of responsiveness.

The *Jupiter* demonstrated beyond doubt the availability of electric machinery for marine propulsion, combining the high efficiency of the steam turbine with all the maneuvering promptness of the reciprocating engine. Later came the *New Mexico,* which confirmed previous experience and removed electric propulsion from the realm of conjecture. Both of these ships, however, used the induction motor, whose low power factor (about 78 percent) necessitates increased sizes of copper conductors and therefore of machinery throughout.

Propelling Machinery of New Cutters

The development of a propelling outfit suitable for small ships of relatively low power was taken up in the summer of 1919, when, in a series of conferences between engineers of the Coast Guard and the General Electric Company, the

*Engineer-in-Chief, United States Coast Guard.

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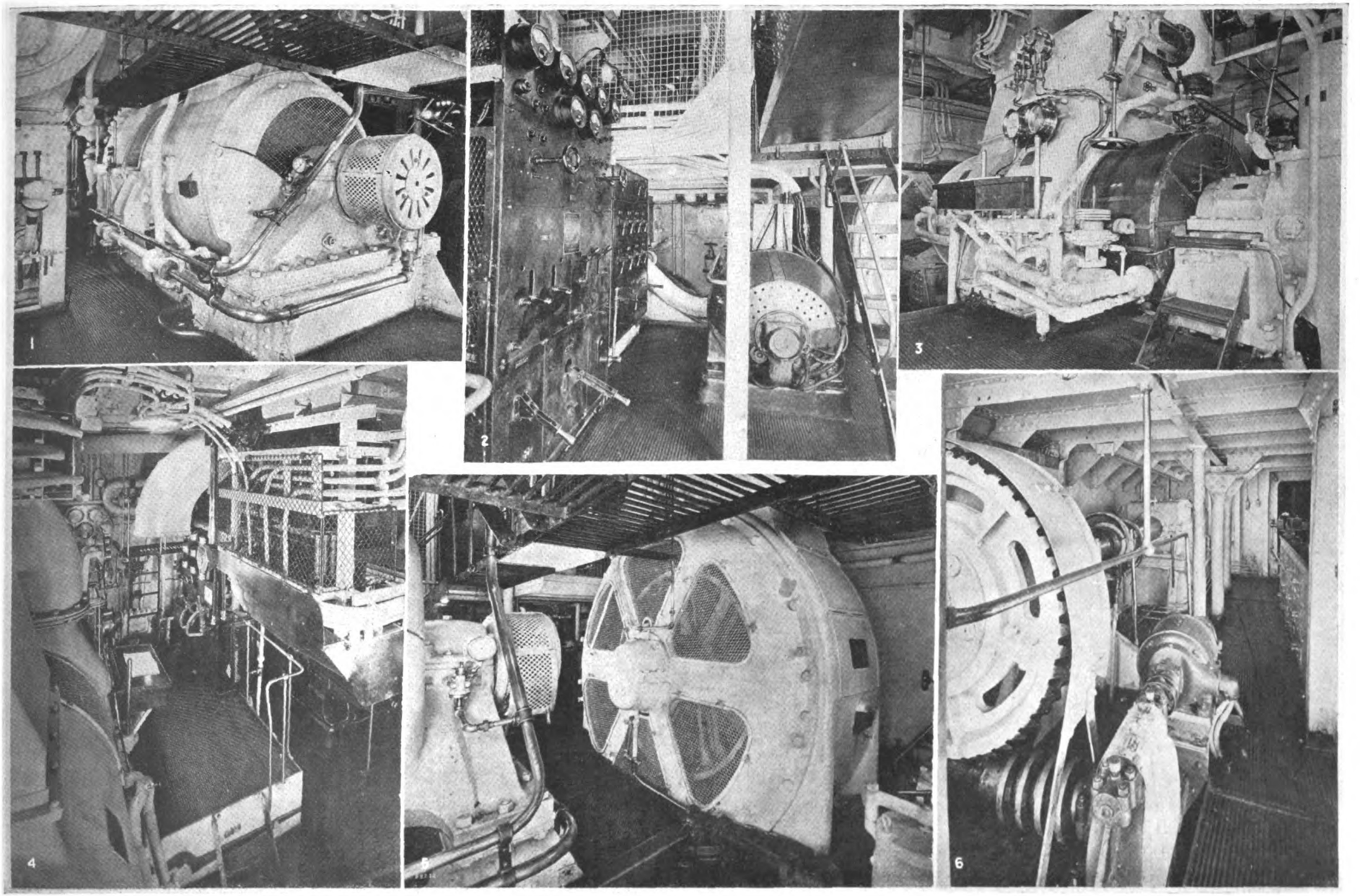

Coast Guard Cutter Tampa: (1) Port Side of Turbo-Generator (looking forward); (2) No. 2 Exciter and Distribution Board; (3) Starboard Side of Turbo-Generator (looking aft); (4) Turbo-Generator, Operating Panel and Control Group; (5) 2,600 Shaft Horsepower Synchronous Motor; (6) Shaft Alley and Engineers' Storeroom

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United States Coast Guard Cutter Tampa

General Information

Service: General police and survey work in territorial waters.

Builder: Union Construction Company, Oakland, Cal.

Owner: United States Government, Treasury Department.

Characteristics

Length, overall	240'-0"
Length, B. P.	220'-0"
Breadth, molded	39'-0"
Depth, molded	25'-6"
Draft, loaded, mean	14'-3"
Draft, light, mean	11'-7"
Block coefficient	0.471
Midship section coefficient	0.89
Area of midship section, square feet	.482
Tons per inch immersion at L.W.L.	13.26
Area of wetted surface, square feet	9,496
Longitudinal coefficient	0.5328
Speed, loaded, knots	16
Cruising radius, nautical miles	
Framing	Transverse
Class	

Tonnages

(In tons of 2,240 pounds)

*Weight of Hull	
**Weight of Propelling Machinery	
Deadweight Capacity	
Displacement, Loaded	1,650

(In tons of 100 cubic feet)

Gross register	1,330.77
Net Register	320.00

*Weight of Hull includes Hull Proper, Hull Fittings, Equipment, and Outfit.

**Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

Canal Ratings

(In tons of 100 cubic feet)

	Gross	Net
Suez		
Panama	1,499.27	202.8

Equipment

2 Bower stockless anchors, each	4,000 lbs.
1 Bower stockless anchor	2,500 lbs.
1 Stream anchor, ex-stock	750 lbs.
1 Kedge anchor, ex-stock	400 lbs.
2 chain cables, 1¾" stud link, each	120 fms.

Rudder

Area, square feet	75.8
Dia. Stock, inches	9
C. Press, abaft C. L. pintles, inches	90.9

Complement

Deck Officers	4
Engineer Officers	3
Medical Officer	1
Deck crew	49
Engineer crew	17
Commissary department	6
Messmen	9
Total officers and crew	89

Handling Equipment

	No.	Type	Capacity	Length
Masts	1	Pole	....	....
Booms	1	....	10,000 lbs.	....
Discharging Capacity				

Deck Machinery

Steering gear, Hydro-electric, Telemotor control	
Windlass, steam, vert., 2 cylinder	8x8
Capstan, electric driven, rope speed 70 feet per minute	

Life Saving Equipment

Lifeboats	No.	Capacity	Length
Monomy surf	2	.....	25
Motor dinghy	1	.....	22
Sailing launch	1	.....	26
Motor sailing launch	1	.....	26
Dinghy	1	.....	18
Surfboat (self-bailing)	1	.....	26
Whaleboat	1	.....	27

Propelling Machinery

Boilers

Number	2
Type, Babcock & Wilcox watertube	
Length of tubes between headers, 9'-0"	
Diameter of drum, inches	42
Burners in each boiler, 4 Peabody	
Fuel	oil
Draft	forced
Total heating surface, including 600 sq. ft. of superheaters, square feet	6,400
Total furnace volume, cubic feet	600
Supheat, degrees F.	50-75
Working pressure, lbs. per sq. in.	200
Smoke pipe, inside diameter	5'-3"
Smoke pipe, height above burners	70'-0"
Normal fuel consumption:	
Per day, tons	
Per horsepower hour, pounds	
Normal steam production:	
Per hour per pound of fuel	lbs.
Total per hour	lbs.

Engines

Main Turbine, Gen. Elect. Curtis Type.

Number of stages	8
Number of nozzles	24
Steam pressure, lbs. per sq. in.	200
Superheat, degrees	75
Vacuum, inches	28
Revolutions per minute	3,000

Main Generator, alternating current type.

Number of poles	2
Number of phases	3
Revolutions per minute	3,000
Kilowatts output	2,040
Volts	2,300

Main Motor, synchronous type.

Number of poles	46
Volts	2,300
Number of cycles	50
Revolutions per minute	130
Shaft horsepower	2,600

Propellers

Number	1
Type	4 bladed, solid cast steel
Weight	
Diameter	13'-0"
Pitch	14'-0"
R. P. M.	130
Projected area, square feet	52.43
Developed area, square feet	63.11

Auxiliary Machinery

Machinery Space

Condenser, (1) main, 3,600 sq. ft. cooling surface	
Condenser, (1) auxiliary, 600 sq. ft. cooling surface	
Evaporator, (1) capacity 6,000 gals. per 24 hrs.	
Distiller, (1) capacity 1,000 gals. per 24 hrs.	
Filters	
Feed water heater, 35,000 gals. per hr. 90° F. to 200° F.	
Fuel oil heaters, (2) 3,000 lbs. per hr., 16° Beaume heated from 60° F. to 200° F.	
Pumps	
(2) Feed vert. simp., dbl. act'g	10 x 6 x 24
(1) Main circulating, 14" centrifugal, turbo-drive	
(1) Main fire, 6" centrifugal, turbo-drive	
(1) Main air, vert., single act'g., twinplex beam	12 x 22 x 18
(2) Fuel oil, vert, dup., dbl. act'g	5¼ x 3½ x 5
(1) Comb. air & circ., horiz. simp., dbl. act'g	7½x10x10x10
(1) Bilge, vert. simp., dbl. act'g.	6½ x 8 x 8
(1) Sanitary, horiz. simp., dbl. act'g.	8 x 8 x 12
(2) Lubricating oil, vert. simp., dbl. act'g	6½ x 7 x 8
(1) Lub. oil cooler, vert. simp., dbl. act'g	7 x 8 x 10
(1) Evap. feed, vert. simp., dbl. act'g	3½ x 4 x 4
(1) Fresh water, vert. simp., dbl. act'g	3½ x 4 x 4
(1) Injector	
(1) 3" Bilge ejector	
(1) Forced draft blower, turbo-driven, capacity 18,000 cu. ft. per min. at 2½" pressure	
(1) Ventilating set, electrically-driven, capacity 18,000 cu. ft. per minute	
(1) Turning gear—5 H. P. electric motor and worm gearing to main shaft	

Refrigerating Machinery

One-ton unit of Audiffren-Singrun type, driven by a 5 horsepower, direct current motor

Electric Equipment

Generators, (2) 225-110 volt, 100 K. W. sets turbo-driven	
Radio	
Emergency	

Refrigerated Space

Compartment	Cu. Ft.
Food	576

Bunkers

Compartment	Cu. Ft.	*Bbls.	*Tons.
Deep Tank-Frs. 36-46 S.	3,720	661	99.2
Deep Tank-Frs. 36-46 C.L.	4,275	759	114.0
Deep Tank-Frs. 36-46 P.	3,720	661	99.2
Total	11,715	2,081	312.4

*37.46 cu. ft. per ton; 42 gals. per bbl.

Tanks

Compartment	Cu. Ft.	Tons F. W.	Tons S. W.
Fore Peak			23.3
Dbl. Bot.-Frs. 47-59 S.	368	10.25	
Dbl. Bot.-Frs. 47-59 C.L.	821	22.85	
Dbl. Bot.-Frs. 47-59 P.	368	10.25	
Dbl. Bot.-Frs. 59-68 S.	537	14.93	
Dbl. Bot.-Frs. 59-68 P.	537	14.93	
Dbl. Bot.-Frs. 68-74 C.L.	462	12.87	
After Peak	357	9.95	
Total	3,450	96.03	23.3

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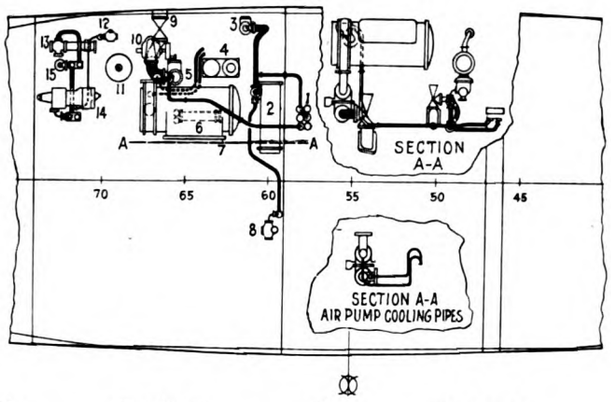
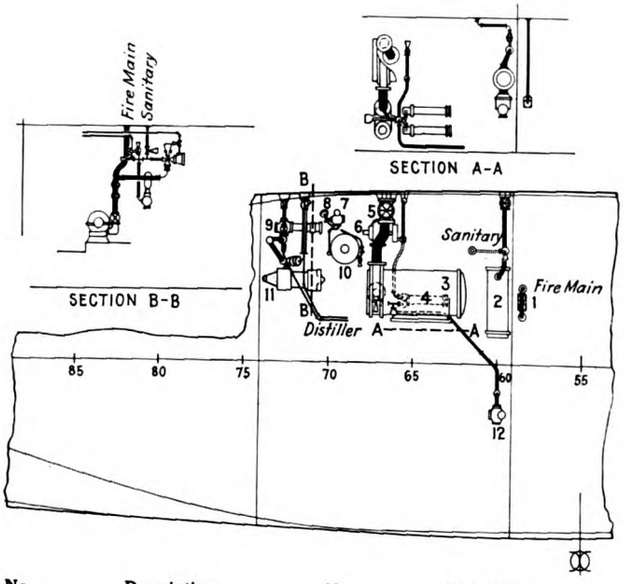


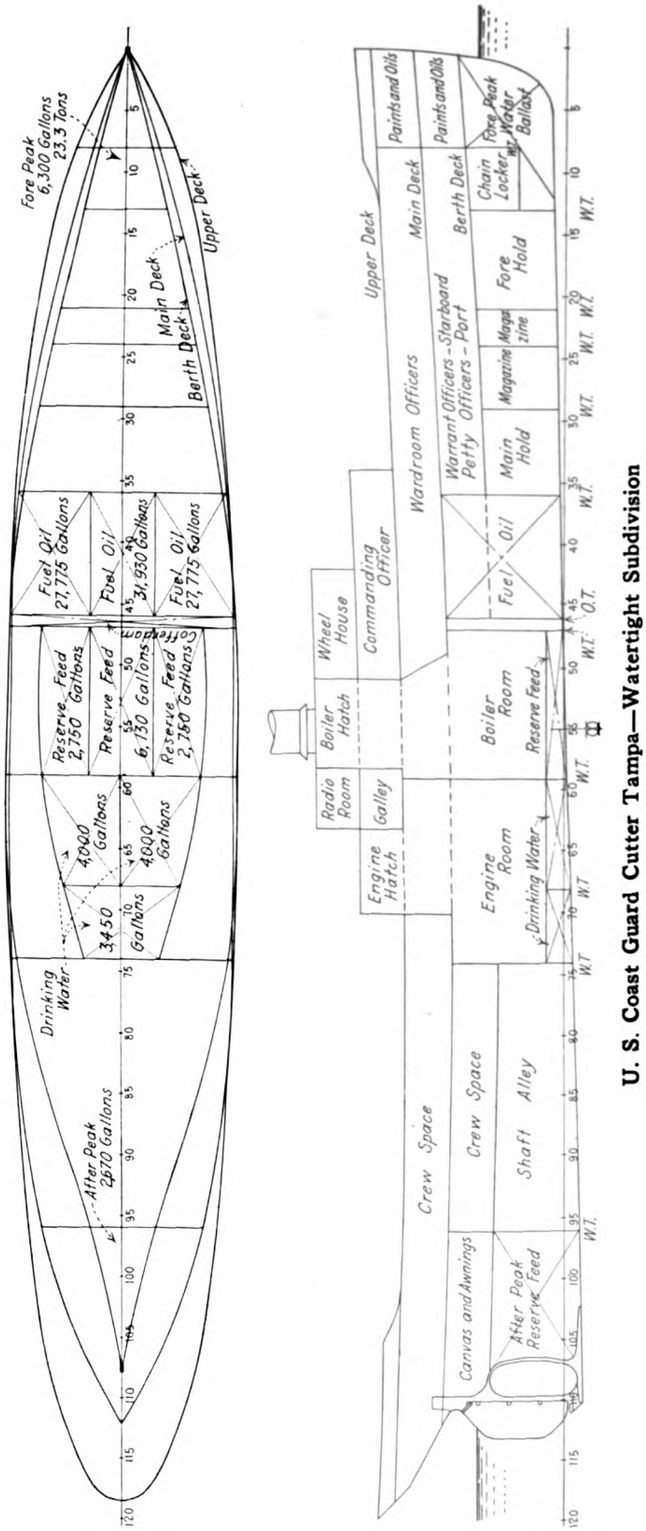
No.	Description	No.	Description
1	Aux. feed pump suction manifold.	8	Lubricating oil cooler pump.
2	Aux. condenser.	9	Main overboard discharge.
3	8-in. sea suction.	10	Main circulating pump.
4	Main air pump.	11	Evaporator.
5	14-in. sea suction.	12	Evaporator feed pump.
6	Lubricating oil cooler.	13	Sanitary pump.
7	Main condenser.	14	Fire pump.
		15	8-in. sea suction.

U. S. Coast Guard Cutter Tampa—Salt Water Suction Piping



No.	Description	No.	Description
1	Aux. feed pump discharge manifold.	7	Evaporator feed pump.
2	Aux. condenser.	8	Evaporator sea blow down.
3	Main condenser.	9	Sanitary pump.
4	Lubricating oil cooler.	10	Evaporator.
5	Main overboard discharge.	11	Main fire pump.
6	Main circulating pump.	12	Lubricating oil cooler pump.

U. S. Coast Guard Cutter Tampa—Salt Water Discharge Piping



U. S. Coast Guard Cutter Tampa—Watertight Subdivision

plant described below was worked out and later installed in the Coast Guard Cutters *Tampa, Haida, Mojave* and *Modoc.*

The main turbo-generator is very similar in all essential characteristics to the machine which the General Electric Company has been building for a number of years for shore stations. The turbine has eight stages, runs at 3,000 revolutions per minute and delivers its power to the generator through a flange coupling. Steam conditions are 200 pounds pressure (gage), 75 degrees superheat and 2 inches back pressure.

Speed regulation is controlled by an oil governor. The speed lever on the operating panel opens a leak-off in the oil system, thereby lowering the pressure. The throttle valve gear is operated by a governor spring working against the oil pressure, so that lowering the oil pressure by means of the leak-off allows the spring to open the pilot valve on the main hydraulic cylinder which increases the opening of the throttle valve.

Auxiliary exhaust steam at 7 pounds (gage) pressure is admitted to the fifth stage of the main turbine. This accomplishes three purposes, all of major importance. It fixes proper conditions for heating the feed water, it utilizes the main turbine to wring all the heat from the auxiliary exhaust and it protects the vacuum against air leaks in the auxiliary exhaust piping.

The main generator is a two-pole, three-phase, 50-cycle machine, generating 2,040 kilowatts at 2,300 volts. One

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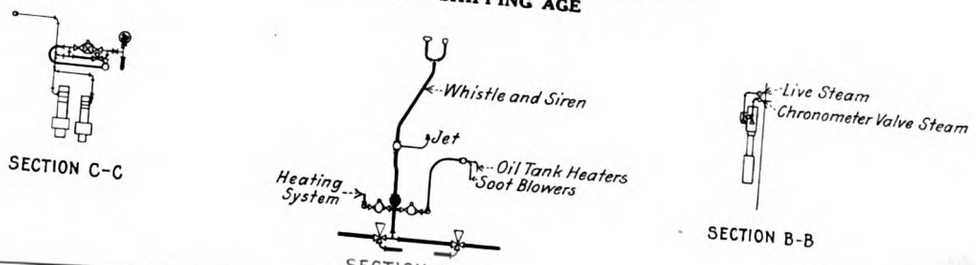
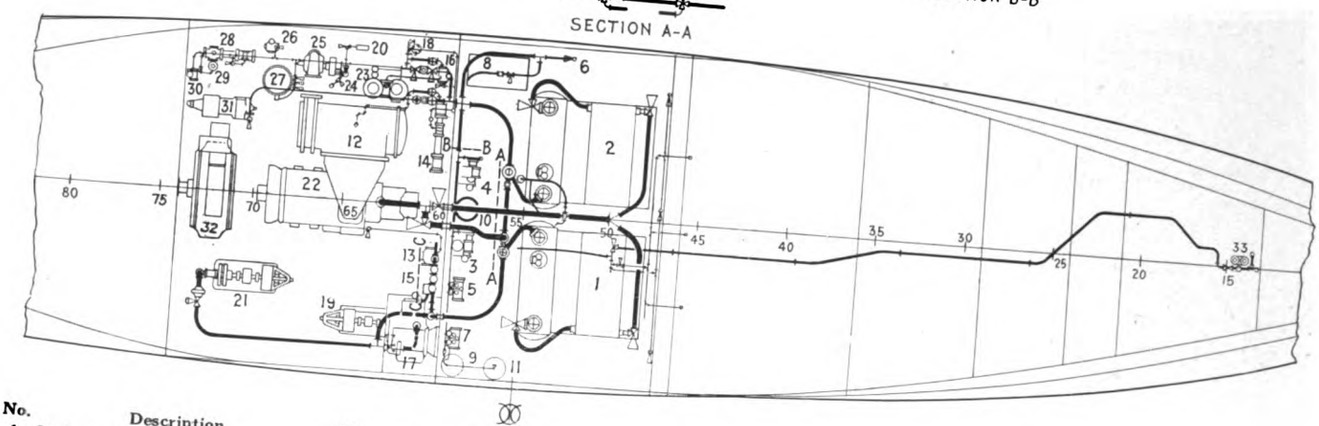




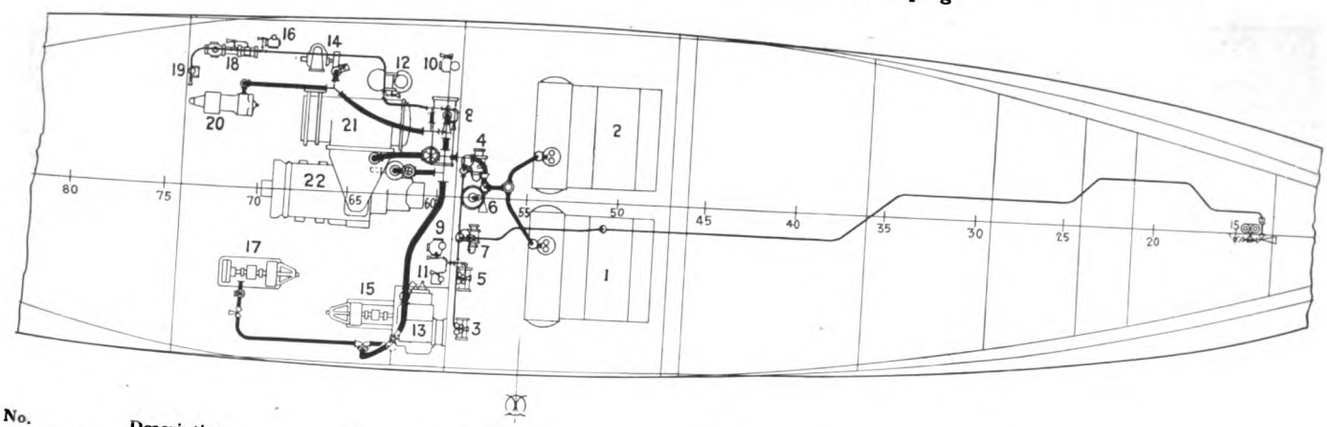
No.	Description
1	Main boiler
2	Main boiler.
3	Main feed pump.
4	Aux. feed pump.
5	Fuel oil pump.
6	Injector.
7	Fuel oil pump.
8	Feed and filter tank.

No.	Description
9	Fuel oil heater.
10	Feed water heater.
11	Fuel oil heater.
12	Main condenser.
13	Lubricating oil cooler pump.
14	Aux. air and circulating pump.
15	Lubricating oil emergency pump.
16	Bilge pump.

No.	Description
17	Turbo fan.
18	8-inch forward sea chest.
19	Forward exciter.
20	Bilge ejector.
21	After exciter.
22	Main turbine generator.
23	Main air pump.
24	14-inch sea chest.

No.	Description
25	Main circulating pump.
26	Evaporator feed pump.
27	Evaporator.
28	Sanitary pump.
29	8-inch aft sea chest.
30	Fresh water pump.
31	Fire pump.
32	Main propelling motor.
33	Anchor engine.

U. S. Coast Guard Cutter Tampa—Steam Piping



No.	Description
1	Main boiler.
2	Main boiler.
3	Fuel oil pump.
4	Aux. feed pump.
5	Fuel oil pump.
6	Feed water heater.

No.	Description
7	Main feed pump.
8	Aux. air and circulating pump.
9	Lubricating oil cooler pump.
10	Bilge pump.
11	Lubricating oil emergency pump.
12	Main air pump.

No.	Description
13	Turbo fan.
14	Main circulating pump.
15	Exciter.
16	Evaporator feed pump.
17	Exciter.
18	Sanitary pump.

No.	Description
19	Fresh water pump.
20	Fire pump.
21	Main condenser.
22	Main turbine generator.
23	Aux. condenser.

U. S. Coast Guard Cutter Tampa—Exhaust Piping

forging is used for the revolving field, shaft and journal. Slots for the windings are milled in the body of the rotor. The field windings are of flat copper strips adequately blocked against motion in any direction and protected by heavy metal wedges and rings.

The propelling motor, however, is the novel part of the installation, for up to the time these ships were designed the synchronous motor had never been proposed for marine propulsion and the motor in the *Tampa* is the first one built for that purpose. Delays of one sort and another, in no way related to the engineering problems, robbed the *Tampa* of the distinction of being the first ship propelled by a synchronous motor, the S. S. *Cuba* having carried off that honor.

Synchronous vs. Induction Motor

The synchronous motor has a number of features which recommend it, rather than the induction motor, for a propelling machine, chief of which is electrical. Alternating current machinery in general has the characteristic that the current lags behind the voltage whenever the circuit is inductive, that is, the induction resists the rise and fall of current and chokes it back behind the voltage. The lag is expressed as an angle in magnetic degrees, just as a geometrical angle is expressed in degrees of arc. The cosine of the angle of lag is called the "power factor." For example, if the current in a circuit lags 37 degrees behind the voltage, the power factor would be the cosine of 37 degrees, or about

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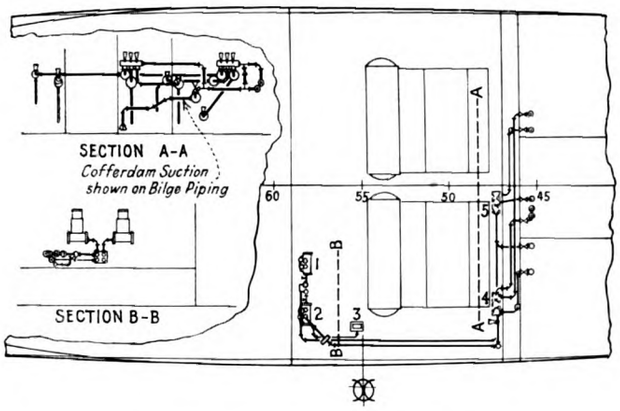
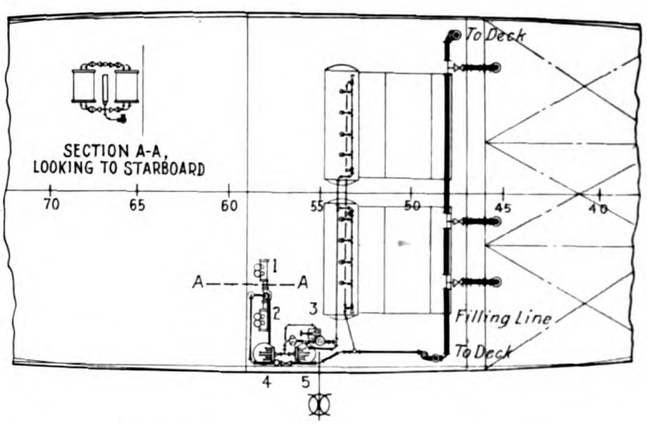


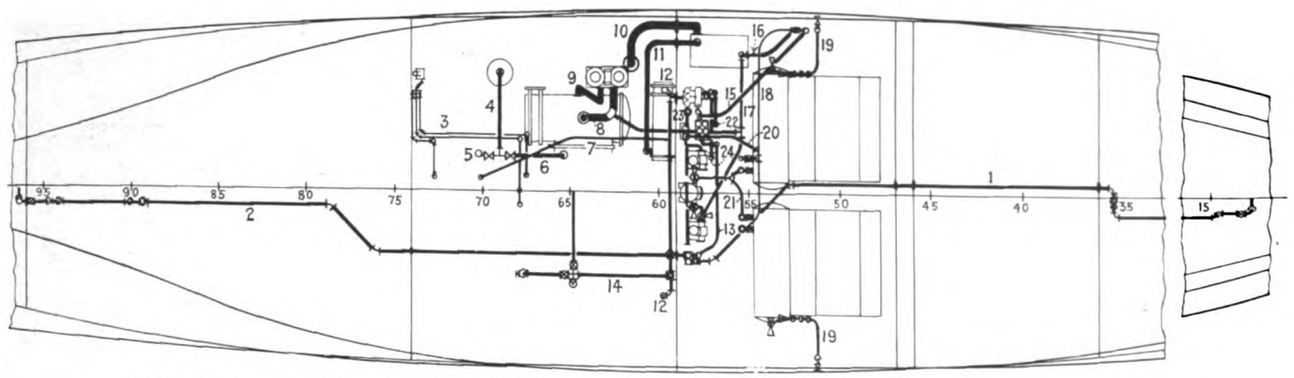
No.	Description	No.	Description
1	Fuel oil pump.	4	High suction manifold.
2	Fuel oil pump.	5	Low suction manifold.
3	Hand fuel oil pump.		

U. S. Coast Guard Cutter Tampa—Fuel Oil Suction Lines



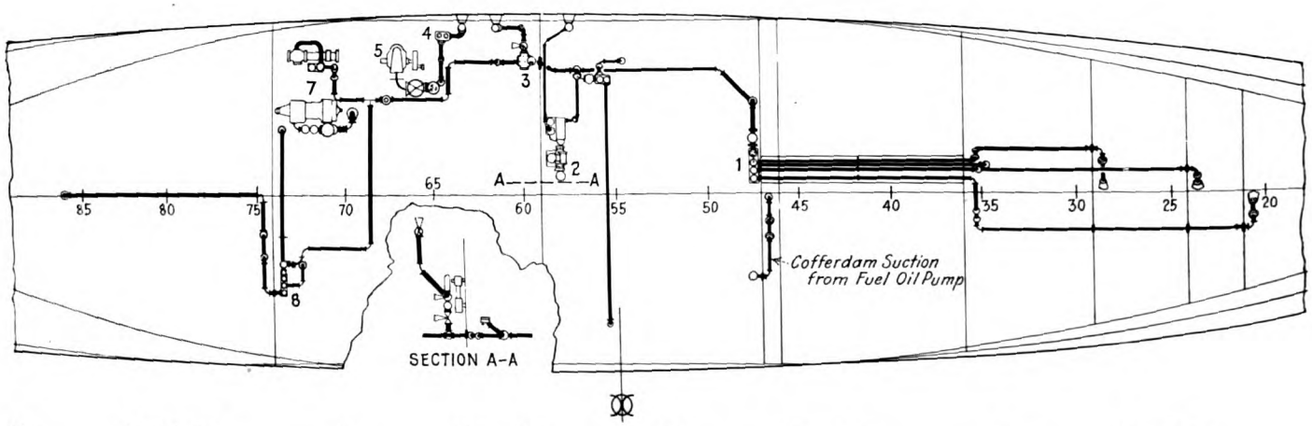
No.	Description	No.	Description
1	Fuel oil pump.	4	Fuel oil heater.
2	Fuel oil pump.	5	Fuel oil heater.
3	Hand fuel oil pump.		

U. S. Coast Guard Cutter Tampa—Fuel Oil Discharge and Filling Lines



No.	Description	No.	Description	No.	Description	No.	Description
1	Fore peak suction and filling.	8	Main air pump wet suction.	15	Injector suction from F.W. tanks.	21	Main feed pump discharge to feed lines.
2	After peak suction and filling.	9	Main air pump dry suction.	16	Injector suction from filter tank.	22	Suction and filling line to port F.W. tank.
3	Pump suctions from drinking tanks.	10	Main air pump discharge to filter tank.	17	Pump suction from filter tank.	23	Suction and filling line to center F.W. tank.
4	Evaporator vapor.	11	Aux. air pump discharge to filter tank.	18	Injector discharge to aux. feed lines.	24	Suction and filling line to starboard F. W. tank.
5	To distiller.	12	Filling pipes from deck.	19	Surface and bottom blow lines		
6	To auxiliary exhaust.	13	Suction and filling line to peak manifold.	20	Aux. feed pump discharge to feed lines.		
7	Distiller discharge to F.W. tanks.	14	Filling line to drinking tanks.				

U. S. Coast Guard Cutter Tampa—Fresh Water Piping



No.	Description	No.	Description	No.	Description	No.	Description
1	Fireroom manifold.	3	Bilge pump.	5	Main circulating pump.	7	Fire pump.
2	Aux. feed pump.	4	Bilge ejector.	6	Sanitary pump.	8	Engineroom manifold.

U. S. Coast Guard Cutter Tampa—Bilge Piping

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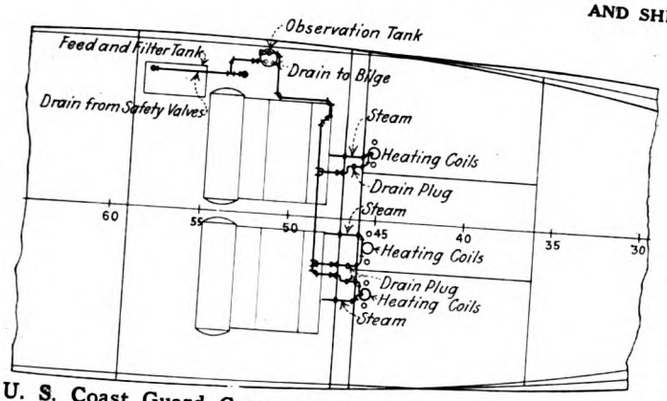
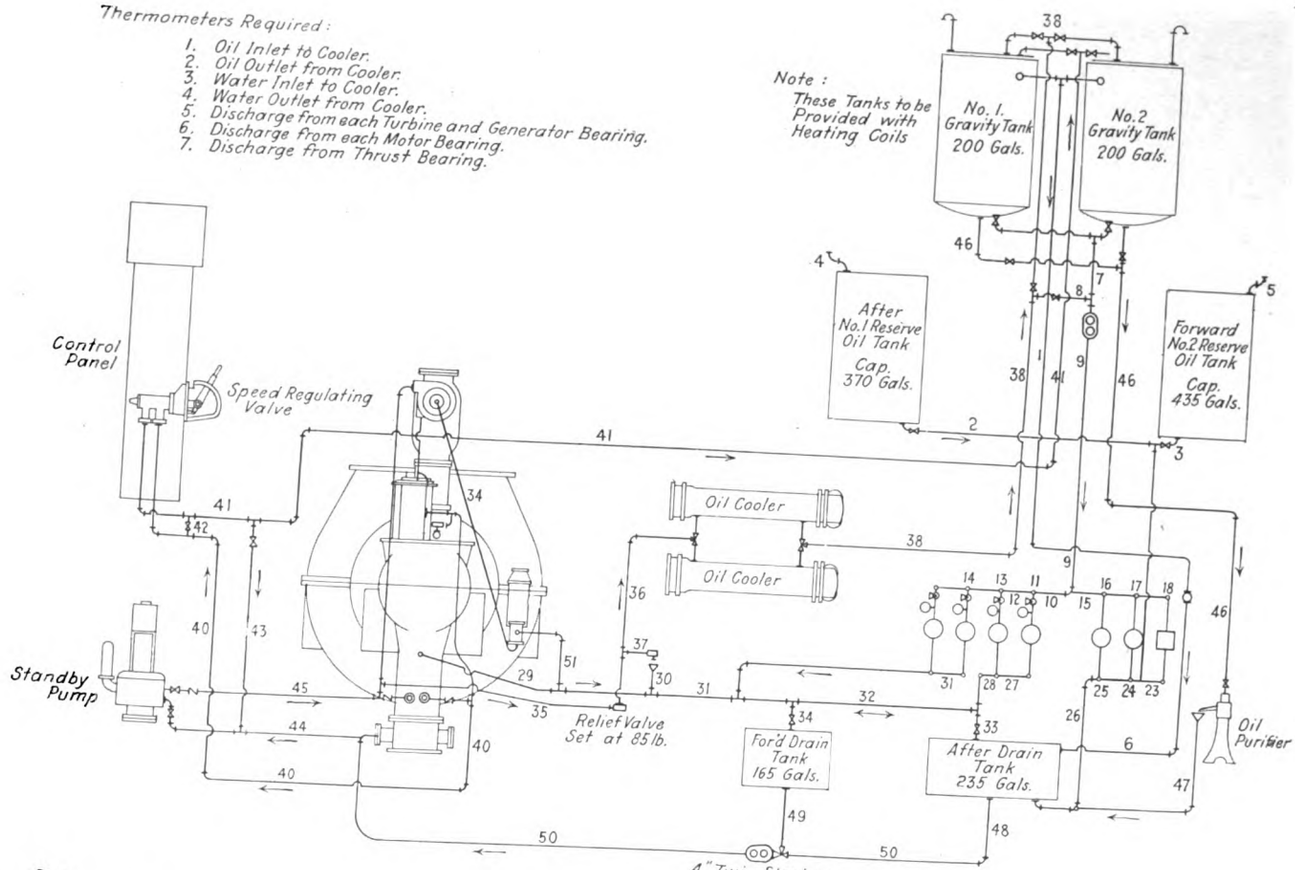


U. S. Coast Guard Cutter Tampa—Fuel Oil Tank Heating Lines

0.80. The effect of power factor is that, instead of taking the product of volts and amperes to get power, that product must be multiplied by the power factor.

In the example cited above the actual power would be only 80 percent of the product of volts and amperes. Heat losses in the main circuit of generator, motor, controls and cables vary with the square of the current, so it is extremely important to keep the current as small as possible, which for any given power requires that the power factor be high. Citing again the 80 percent factor and comparing it with a 100 percent power factor the sizes of all conductors in the main circuit would be in the ratio of about 1½ to 1 with a corresponding difference in size and weight of the whole machine. And, be it noted, 80 percent is a high power factor for an induction motor suitable for ship propulsion, whereas


Thermometers Required:
1. Oil Inlet to Cooler.
2. Oil Outlet from Cooler.
3. Water Inlet to Cooler.
4. Water Outlet from Cooler.
5. Discharge from each Turbine and Generator Bearing.
6. Discharge from each Motor Bearing.
7. Discharge from Thrust Bearing.
Note: These Tanks to be Provided with Heating Coils
No. 1. Gravity Tank 200 Gals.
No. 2 Gravity Tank 200 Gals.
After No. 1 Reserve Oil Tank Cap. 370 Gals.
Forward No. 2 Reserve Oil Tank Cap. 435 Gals.
Control Panel
Speed Regulating Valve
Oil Cooler
Oil Cooler
Standby Pump
Relief Valve Set at 85 lb.
For'd Drain Tank 165 Gals.
After Drain Tank 235 Gals.
Oil Purifier
4" Twin Strainer

Line	Size, in.	Service
1	3	Overflow from gravity tanks.
2	3	Makeup from No. 1 reserve oil tank.
3	3	Makeup from No. 2 reserve oil tank.
4	3	Starboard filling line.
5	3	Port filling line.
6	3	Makeup and overflow to after drain tank.
7	2½	Bearing supply from gravity tanks to strainers.
8	2	Cross connection from cooler discharge.
9	2½	Supply line.
10	2	Supply to generator and turbine bearings.
11	¾	Supply to after generator bearing.
12	1½	Supply to generator and turbine bearings.
13	¾	Supply to middle bearing.
14	1¼	Supply to turbine thrust and forward bearings.
15	1¼	Supply to motor and thrust bearings.
16	½	Supply to forward motor bearing.
17	½	Supply to after motor bearing.
18	1	Supply to thrust bearing.
19	1	Drain from after end of thrust, not shown.
20	1	Drain from center of thrust, not shown.
21	1	Drain from forward end of thrust, not shown.
22	2	Overflow from thrust not shown.
23	2	Drain from thrust.
24	1¼	Drain from after motor bearing.
25	1¼	Drain from forward motor bearing.
26	3	Drain from motor and thrust.
27	2	Drain from after generator bearing.
28	2	Drain from middle generator bearing.
29	1½	Overflow from gear pump casing.
30	2	Relief valve discharge from cooler line.
31	3	Forward drain header.
32	3	After drain header.
33	3	Drain to after tank.
34	3	Drain to forward tank.
35	1½	Pump discharge to coolers.
36	2	Discharge to coolers.
37	2	Relief line from discharge to coolers.
38	2	Discharge from coolers to gravity tanks.
39	2	Connection from hydraulic cylinder to aux. steam adms. valve.
40	1½	Connection from variable speed gov. to speed reg. valve.
41	1½	Speed regulating valve discharge to gravity tanks.
42	¼	Speed regulating valve by-pass.
43	1½	Pump suc. from speed regulating valve discharge.
44	1½	Stand by pump suction from drain tanks.
45	1½	Stand by pump discharge to hydraulic cylinder.
46	1	Drain from gravity tanks to purifier.
47	¾	Purifier discharge to line 26.
48	4	Pump suction from after drain tank.
49	4	Pump suction from forward drain tank.
50	4	Pump suction.
51	½	Drain from aux. steam admission valve.

U. S. Coast Guard Cutter Tampa—Lubricating Oil System

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the power factor of a synchronous motor is 100 percent. The difference in weight and size is sufficient, in the case of these Coast Guard ships, to determine the possibility of electric drive, i. e., the synchronous motor could be used but the induction motor could not.

The next most important difference between the two types of motors is a mechanical difference with an electrical reason. In order to get as high a power factor as possible, the induction motor must have the smallest possible air gap between stationary and rotating parts, with the result that only limited wear can take place in the bearings before there would be trouble. The air gap of the synchronous motor is usually about ⅜ inch making such trouble extremely improbable. In addition there is a very real advantage in the accessibility of a synchronous motor for repairs. The direct current poles are radial pieces bolted on the outside of the rim of the rotor wheel. They are readily detachable and by removing a few of them any part of the stator windings can be removed or repaired without having to lift heavy weights.

Alleged objections to the synchronous motor, on the part of people who ought to know better, have been urged so persistently as to create honest doubts of its merits. A synchronous motor is alleged to have poor starting qualities when as a matter of fact it has none at all. Neither has a disengaged clutch. But nobody leaves a clutch disengaged, if he wants it to work; neither does he try to get starting torque in a pure synchronous motor. He puts on a simple, cheap and effective squirrel cage winding which brings the motor up to speed and then goes out of business. Such motors have been used successfully for years in rolling mills, probably the most rigorous conditions to be found anywhere, reversing under terrific load every few seconds year in and year out; yet the question is raised whether it will reverse a ship's propeller. Anyhow the question is answered; the *Tampa* has been brought dead in the water from 15 knots in her own length, which should be rapid enough to satisfy the most exacting.

The theory that the motor would fall out of step in a sea way has also been disproved.

The question of whether the addition of a direct current field constitutes an objectionable complication may be a matter of opinion. The theory of this field is simple and readily understood and, if there are more switches, etc., required, they are all mechanically rugged and easily kept in order. The complication is no greater than in an induction motor with external secondary resistances and not so great as in an induction motor with apparatus for improving the power factor.

The motors used in the Coast Guard have 46 poles, giving a speed reduction of 23 to 1. The power developed is 2600 shaft horsepower at 130 revolutions per minute.

Duplicate exciters are installed. Each is a turbine-driven, three wire, 240 volt generator, furnishing sufficient current for excitation and for all lighting and power purposes.

Engineers Extol Westinghouse

"The Life of George Westinghouse," by Col. Henry G. Prout, will soon be published by the American Society of Mechanical Engineers for the following committee: Charles A. Perry, chairman, Paul D. Cravath, Alexander C. Humphreys, James H. McGraw, H. G. Prout, Charles F. Scott, L. B. Stillwell, Ambrose Swasey, H. H. Westinghouse.

"To the memory of few other men, if any, do the engineers of America owe so great a debt of gratitude as to that of George Westinghouse, whose inventions and achievements have not only benefited mankind, but have made possible the enterprises in which so many of our number are now engaged," said Calvin W. Rice, secretary of the society, in a statement explaining that "the underlying motive for publishing a biographic series of great American engineers is to inspire others."

Railroad Contracts With Foreign Shipping Lines

(*Concluded from page* 12.)

would route business that was to be transferred to ocean-going ships, the vice-president declared that his road does not route business at all but merely advertises sailings and allows shippers to choose. And, he stated furthermore, that if there is a congestion of vessels at the docks, all are required to take their turn, regardless of whether of a contract line or not.

Berthing Facilities Denied American Vessels

Despite these assurances the Shipping Board commissioners were plainly dubious regarding the effect of contracts with foreign lines. The chairman said that he knew of actual cases where berthing facilities had been denied to American vessels because of the existence of such agreements. It availed nothing that a railroad company had a fine moral feeling for American shipping, if it was confronted with the physical inability to accommodate American ships because of foreign contracts. With a record of two and one-half million tons of cargo interchanged last year between the ten American railroads represented at the hearing and ships operating under the flags of nations other than the United States it was imperative that steps be taken to give effect to Section 28 of the Merchant Marine Act which clearly defines the intent of Congress that American railroads be preferential feeders of tonnage for American ships.

As an earnest of the harmlessness of existing contracts, the vice-president of the Baltimore & Ohio said that the agents of the Donaldson Lines and Furness Withy and Company had already recommended to their principals that their contracts be cancelled, such was their realization that under present conditions in the United States, such contracts could give to a foreign shipping interest no service or co-operation not available to all rivals. But for all that the Baltimore & Ohio contracts were, in his estimation, virtually inoperative, the vice-president hesitated, on his own initiative, arbitrarily to cancel contracts entered into in good faith with responsible people unless the contractors were willing. Other railroad executives who were present were much more ready to meet the wishes of the Shipping Board without debate or delay. For example, Vice-President L. Green, in charge of traffic of the Southern Railway and Mobile and Ohio Railroad, stated that from what he had heard at the conference he sensed the sentiment of the Shipping Board and that, unless the Board requested him not to do so, he would forthwith take steps to cancel the contracts held by his roads. The attitude of several of the railroad executives is that the contracts that the Shipping Board is objecting to have served their purpose and might as well be scrapped. Owing to the change of conditions, they hold that such contracts can no longer be preferential. Each road and each shipping company is now compelled to work for business wherever it can get it.

Senator France of Maryland has introduced in the Senate a bill, S. 2620, to provide a fundamental change in the method of determining wage scales for employees of government navy yards and arsenals. The bill provides for the creation of a board of adjustment which shall have final jurisdiction and authority to decide upon all questions relating to changes in wage scales and controversies or grievances concerning conditions of labor. The board would be composed of three members.

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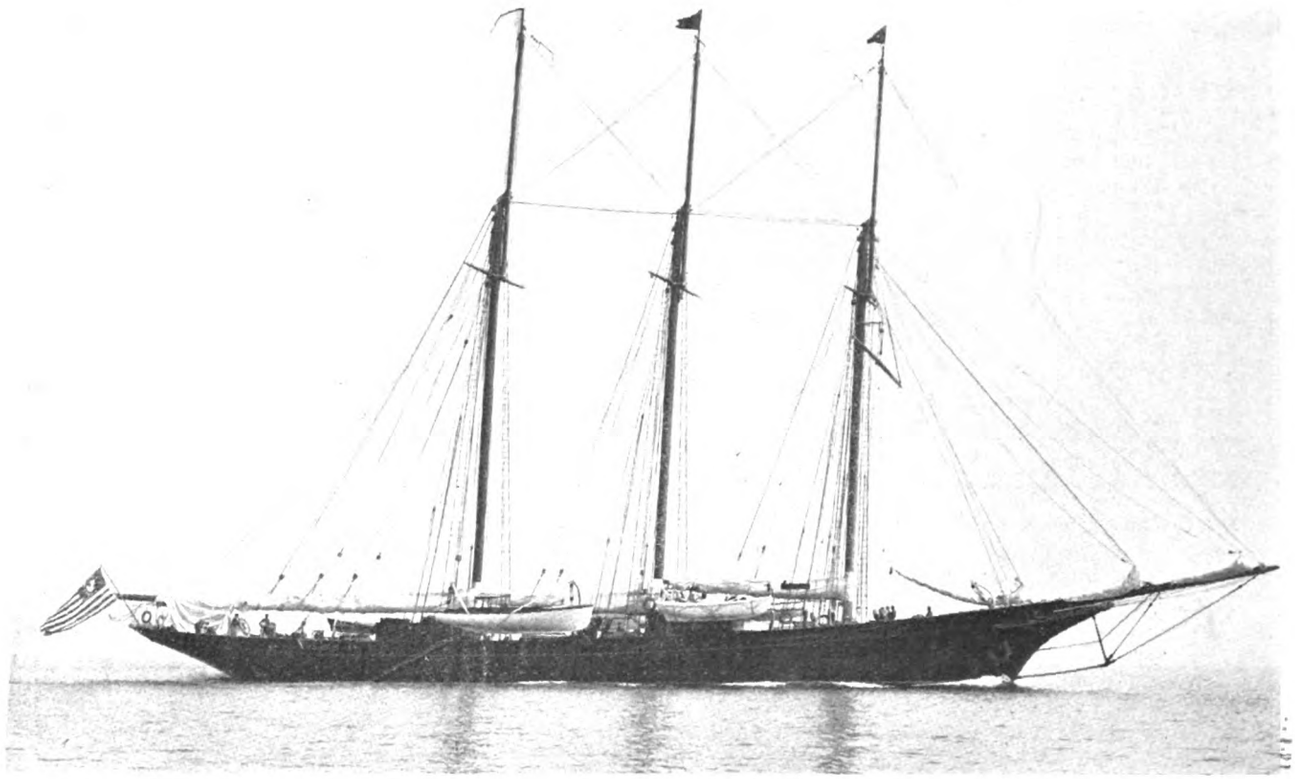


(*Photograph copyright, 1921, by Edwin Levick, N. Y.*)

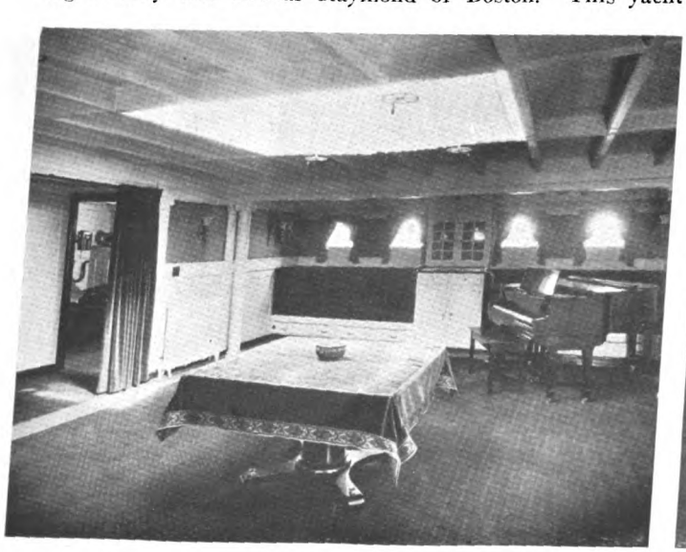
Edgar Palmer's Three Masted Auxiliary Schooner Yacht Guinevere

Auxiliary Schooner Yacht Guinevere

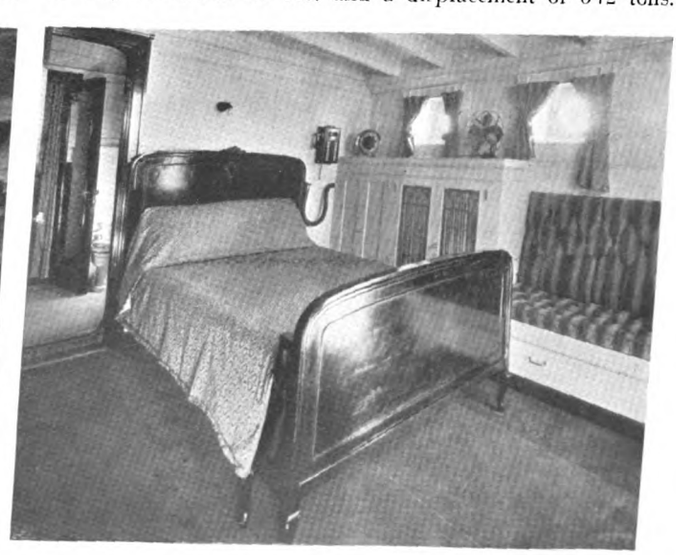
The Largest Fore-and-Aft Auxiliary Schooner Yacht Ever Built Equipped with Diesel Electric Drive

THE successful 14,000-mile cruise of the auxiliary schooner *Elfay*, which had the first Winton Diesel-electric drive ever installed in a vessel, influenced Edgar Palmer of New York to include a similar type of propelling unit in his new yacht *Guinevere* designed by A. Loring Swasey and Arthur Raymond of Boston. This yacht has the distinction of being not only the largest Diesel yacht built in this country but also the largest fore-and-aft auxiliary schooner yacht in the world.

The *Guinevere* has an overall length of 195 feet, a length on the waterline of 150 feet, a molded beam of 32 feet 5 inches, a draft of 15 feet and a displacement of 642 tons.



Main Saloon



Owner's Bedroom

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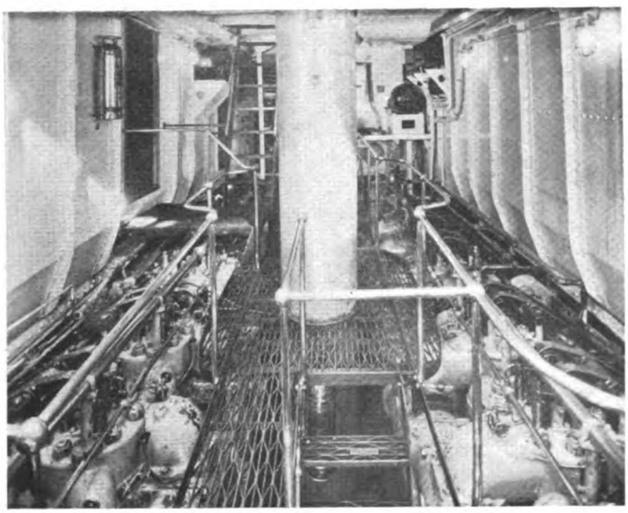
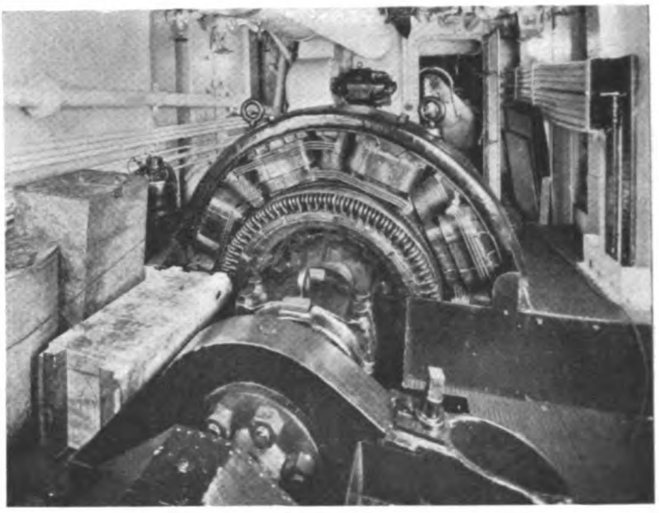


View of Engine Room from Upper Grating



550 Horsepower Propelling Motor

The power plant consists of two Winton Diesel engines which develop a total of 700 horsepower. Each engine is direct connected to a 225-kilowatt Westinghouse shunt wound generator. Current for propelling the yacht is supplied through the main switchboard to a 550-horsepower Westinghouse electric motor which gives the vessel a speed of 11½ knots without employing her sails. The electric propelling unit was worked out by the designers with suggestions from Commander Fisher of the United States Navy. The yacht has a fuel capacity of 95 tons of oil and stowage space for supplies sufficient for a cruising radius of 11,000 miles.

The Winton Engine Works and the Westinghouse Electric & Manufacturing Company constructed the power plant and driving generators and motors. The ship was built by the George Lawley & Son Corporation at their yards in Neponset, Mass.

Deck House and Cabin Arrangement

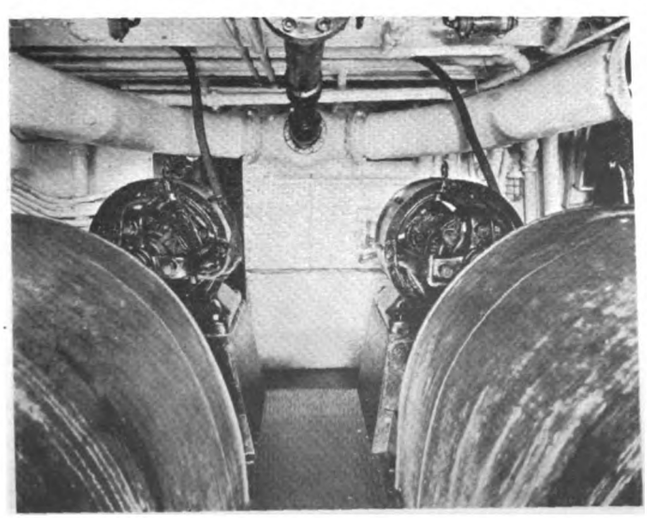
The comparatively small space occupied by machinery in the hull allows a roomy arrangement of cabins below decks and more spacious living accommodations, crew's quarters, capacity for stores and the like than is generally the case in auxiliary yachts, especially if they are steam driven. In addition to these advantages the stack is eliminated allowing space for an extra deck house. The exhaust is at the after end of the boat under water so that soot and gas fumes are carried well away from the yacht.

The main power plant consists of a pair of 6-cylinder 350-horsepower model 24-A Winton Diesel oil engines having a bore of 13 inches, a stroke of 18 inches and an operating speed of 225 revolutions per minute. Each engine is direct connected to a 225-kilowatt Westinghouse shunt wound generator, which in turn operates through a chain drive a 15-kilowatt, 125-volt direct current compound-wound Westinghouse exciter, turning at 1,150 revolutions per minute. This power unit supplies current to a 550-horsepower, 250-volt Westinghouse propelling motor operating at 220 revolutions per minute located in the stern.

Propeller

The propeller, constructed according to the Bevis patents, is two-bladed, having a diameter of 8 feet 4 inches. The greatest advantage of the twin engine drive installed in the *Guinevere* is its maneuvering ability as well as the possibility of cruising at reduced speed on one engine or at full speed on both engines if it is desired. In the case of engine repairs a single engine and generator unit is able to carry the load while the other unit is shut down.

An interesting feature of the installation is that the generators are not only ring-oiled, as is the usual practice, but provision is also made for flooding them with oil from the lubricating systems of the Diesel engines. This provision is made so that they will operate satisfactorily whatever the list of the ship might happen to be.



Generators and Exciters

Galley, Showing Electric Range

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The driving motor is enclosed at its forward end, but an inlet is provided at the top for the intake of cooling air. Centrifugal fans direct connected to a 1¾-horsepower motor furnish approximately 3,500 cubic feet of air per minute for ventilating the propelling motor.

METHOD OF OPERATION

The method of operation for this drive is practically the same as that used in the auxiliary schooner yacht *Elfay*. For cruising at full power the two main generators are connected in series furnishing current to the motor. The generators and motor are in this case arranged for separate excitation at 125 volts on the exciter circuit. The speed of the motor from zero to maximum in either direction is controlled by means of the reversing rheostat which controls the excitation of both generators and thus the generator voltage, which determines the speed of the motor. This arrangement makes it possible to operate the ship at almost any speed desired up to the maximum ahead or astern. It also allows for reversing without interrupting the main circuit.

Unlike the *Elfay* the *Guinevere* power plant is controlled from the engine room by signals from the pilot house. The reversing rheostats are mounted at the rear of the switchboard panel and are operated by a hand wheel suitably marked on the front of the panel board. In addition to the reversing rheostat this panel carries an automatic circuit breaker for overload production, motors, knife switches for the generator and motor field circuit, and a two-pole double-throw knife switch for each main generator armature circuit. By means of the latter switches each generator may be connected in series with the other generator or disconnected, leaving the other generator connected to the motor. This arrangement makes it possible to operate at reduced speed when one generator is shut down or when it is desired to operate the ship at low speed for a considerable length of time. Each of these switches has an extra auxiliary control panel in case that it becomes necessary to use more power than is supplied by the auxiliary generating units.

AUXILIARY EQUIPMENT

The auxiliary equipment aboard the *Guinevere* includes a two-ton Clothel ice machine and a pair of 15-kilowatt generators for auxiliary work, each of which is operated by a 25-horsepower Quayle engine. All other auxiliary equipment throughout the boat, such as bilge pumps, fire pumps, service pumps, ventilating fans, hoists, both anchor and sail, wireless equipment and the like are operated by electric power, no steam being used on the boat. The galley equipment, ovens, heaters, hot pans and the like are all heated by electricity. Electric radiators are used for heating the living quarters and cabins throughout the yacht.

GYRO STABILIZER INSTALLED ON GUINEVERE

To give greater steadiness at sea while sailing under power the *Guinevere* has been fitted with a Sperry gyro stabilizer of the active type. The rotor for the stabilizer is 78½ inches in diameter by 17¼-inch face and weighs about 22,000 pounds. It is designed to operate at 1,700 revolutions per minute. Because of the air friction against the revolving element, which increases almost as the third power of the peripheral velocity when the gyro is running at more than half speed, the casing in which the wheel is enclosed has been exhausted of air to a 15-inch vacuum thus reducing the windage losses and saving about 13-horsepower on the equipment. On the *Guinevere* power is supplied for the driving motors of the gyro from the main generators through the main switchboard. The stabilizer equipment is installed in a special compartment just forward of the engine room.

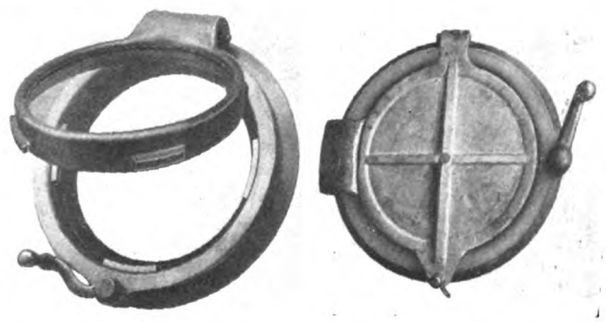
Following out the plan to have the yacht as completely controlled by electricity as possible, she is fitted with a Sperry gyro compass. A repeating compass, electrically operated by the master gyro, is located in the owner's quarters.

The *Guinevere* reently completed her sea trials and a full power run from Boston to New York on which the yacht's performance was satisfactory. She was then fitted out for an extended Atlantic cruise and is now on a run to Cuba.

Air Port Operates on Breech Block Principle

TO facilitate the opening and closing of air ports and to eliminate the glass breakage caused by uneven tightening of tumble bolts the Steward Davit and Equipment Corporation, New York, has produced a new type port which is controlled by the turning of a small handle.

The appearance of the glass frame of this port is similar to the conventional type except that in place of the dogs for tumble bolt nuts it has four fixed wedges on its outer circumference. Inside a fixed frame which is attached to the ship's plating is located a ring gear which has teeth on its outer edge for about a quarter of the circumference. These



Air Port Open Deadlight Closed

teeth are operated by a small pinion attached to a crank handle. On the outer edge of the ring gear opposite the gear teeth is a section made in the form of an interrupted spiral gear which engages with a second spiral gear attached to the cover hinge. The ring gear also has four wedges on its inner circumference which engage the wedges on the glass frame.

To open the port the crank handle is turned and this revolves the ring gear until the wedges clear those on the glass frame. Continuing to turn the handle causes the ring gear spiral to engage with the spiral on the hinge and opens the light. The handle, wedges and spiral gears are timed in such a way that the handle clears the opening light, the wedges clear and then the spirals engage—all in one continuous motion. The light is thus opened and held in position at any angle without any further operation.

To close and tighten the port the motion is reversed; the whole movement being similar to the operation of the breech block on a heavy gun.

British Lines Cut Rates

VICE-PRESIDENT LOVE of the Emergency Fleet Corporation said on December 7 that reports from London that British steamship lines were planning a rate war against United States vessels were based on a rate war between British lines. According to official reports to the board, the action of the British lines was taken without regard to competition by American vessels.

Mr. Love said it appeared that the Ellerman Line, a British company, had announced it would enter the European-Pacific coast trade and that then three other British lines already in that service—the Furness, Harrison and Holt companies—met that announcement with cutting their rates in half.

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American Shipbuilding Returns for 1921

Shipyard	Merchant vessels completed in 1921			Naval vessels completed in private yards in 1921			Merchant vessels now under construction			Naval vessels now under construction in private shipyards		
	Number of ships	Total gross tonnage	Total horsepower	Number of ships	Total displ. tonnage	Total horsepower	Number of ships	Total gross tonnage	Total horsepower	Number of ships	Total displ. tonnage	Total horsepower
American Bridge Company	72	4,390	.....	....	.....	.....	31	1,202	.....	.....	.....	.....
American Car & Foundry Company	3	1,200	.....	....	.....	.....	3	1,500	.....	....	.....	.....
Anchor Shipbuilding Company	1	.....	220	....	.....	.....	....	.....	.....	....	.....	.....
Baltimore Dry Docks & Shipbuilding Company	7	34,477	13,800	....	.....	.....	3	11,714	4,650	....	.....	.....
Bethlehem Shipbuilding Corporation, Limited	30	212,333	89,500	18	22,050	504,000	16	149,265	67,950	34	127,108	460,600
Bath Iron Works, Ltd	1	6,250	2,200	....	.....	.....	.	3,875	2,000	....	.....	.....
F. S. Bowker & Sons	1	698	.....	....	.....	.....	....	....	.....	....	.....	.....
Chickasaw Shipbuilding & Car Company	7	42,000	21,000	....	.....	.....	....	....	.....	....	.....	.....
Consolidated Shipbuilding Corporation	....	.....	.....	3	1,700	1,800	....	....	.....	....	.....	.....
Wm. Cramp & Sons Ship & Engine Building Company	2	8,699	6,600	2	2,430	56,000	....	....	.....	....	.....	.....
Oscar Daniels Company	3	19,768	9,600	....	.....	.....	1	7,800	4,000	5	35,500	450,000
Dellut & Williams Shipbuilding Company	2	13,600	5,600	....	.....	.....	....	....	.....	....	.....	.....
Downey Shipbuilding Corporation	1	550	.....	....	.....	.....	....	....	.....	....	.....	.....
Dravo Contracting Company	31	8,121	.....	....	.....	.....	20	7,000	.....	....	.....	.....
Defoe Boat & Motor Works	....	.....	.....	8	6,500	2,800	4	660	725	....	.....	.....
John Eichleay, Jr., Company	4	850	1,100	....	.....	.....	2	850	1,650	....	.....	.....
Electric Boat Corporation	(Does not build except through subsidiaries)											
Federal Shipbuilding Company	8	69,450	26,800	....	.....	.....	....	....	.....	....	.....	.....
George A. Fuller Company	4	6,121	12,000	....	.....	.....	....	....	.....	....	.....	.....
Globe Shipbuilding Company	2	16,416	3,000	....	.....	.....	....	....	.....	....	.....	.....
Great Lakes Engineering Works	1	1,255	3,000	....	.....	.....	....	....	.....	....	.....	.....
Groton Iron Works	1	826	400	....	.....	.....	....	....	.....	....	.....	.....
Green, Richard T., Company	1	464	400	....	.....	.....	....	....	.....	....	.....	.....
Hanlon Dry Dock & Shipbuilding Company	.....	.....	.....	....	.....	.....	1	1,500	1,000	....	.....	.....
The Humphreys Railways, Inc	1	141	100	....	.....	.....	1	310	300	....	.....	.....
Johnson Iron Works, Dry Dock & Shipbuilding Company, Inc	6	1,600	.....	....	.....	.....	2	700	.....	....	.....	.....
Kelley-Spear Company	2	3,252	.....	....	.....	.....	....	....	.....	....	.....	.....
Kyle & Purdy, Inc	3	2,250	1,350	....	.....	.....	1	250	150	....	.....	.....
Kanawha Dock Company	1	154	600	....	.....	.....	....	.....	.....	....	.....	.....
Los Angeles Shipbuilding & Drydock Company	7	56,000	24,500	....	.....	.....	....	.....	.....	....	.....	.....
The Lake Torpedo Boat Company	....	.....	.....	3	3,276	3,000	....	.....	.....	....	.....	.....
McClintock Marshall Company	10	7,500	.....	..	.....	.....	....	.....	.....	4	4,888	7,200
McDougall-Duluth Company	5	5,200	1,400	....	.....	.....	....	.....	.....	....	.....	.....
Manitowoc Shipbuilding Corporation	1	1,407	800	....	.....	.....	1	140	600	....	.....	.....
Marietta Mfg. Company	12	12,809	13,800	....	.....	.....	1	355	400	....	.....	.....
Merchant Shipbuilding Corporation	7	42,072	21,150	....	.....	.....	2	16,000	9,000	....	.....	.....
Merrill-Stevens Shipbuilding Corporation	1	300	.....	....	.....	.....	....	.....	.....	....	.....	.....
Midland Barge Company	5	2,000	.....	....	.....	.....	....	.....	.....	....	.....	.....
Moore Shipbuilding Company	11	82,800	39,500	....	.....	.....	....	.....	.....	....	.....	.....
Main Iron Works	4	1,900	4,000	....	.....	.....	1	1,000	1,000	....	.....	.....
Nashville Bridge Company	22	6,150	250	....	.....	.....	5	1,500	550	....	.....	.....
Newburgh Shipyards, Inc	4	11,935	12,000	....	.....	.....	....	.....	.....	....	.....	.....
New Jersey Dry Dock & Transportation Company	3	1,672	1,200	....	.....	.....	....	.....	.....	....	.....	.....
Newport News Shipbuilding & Dry Dock Company	6	77,150	37,200	1	32,660	34,000	....	.....	.....	4	162,800	454,000
New York Harbor Dry Dock Corporation	....	.....	.....	....	.....	.....	2	6,570	3,200	....	.....	.....
New York Shipbuilding Corporation	19	206,357	158,600	4	5,892	108,000	4	38,100	26,000	3	108,700	234,600
Pacific Coast Shipbuilding Company	2	18,800	5,600	....	.....	.....	....	.....	.....	....	.....	.....
Pittsburgh Steel Company	1	1,400	.....	....	.....	.....	....	.....	.....	....	.....	.....
Pusey & Jones Company	3	11,546	6,000	....	.....	.....	....	.....	.....	....	.....	.....
Rice Brothers Company	....	.....	.....	....	.....	.....	4	1,600	.....	....	.....	.....
Riter Conley Manufacturing Company	10	2,500	.....	....	.....	.....	....	.....	.....	....	.....	.....
Geo. D. Ryan & Son	3	1,040	100	....	.....	.....	....	.....	.....	....	.....	.....
Saginaw Shipbuilding Company	1	4,250	1,500	....	.....	.....	....	.....	.....	....	.....	.....
San Diego Marine Construction Company	1	100	120	....	.....	.....	....	.....	.....	....	.....	.....
Southern Shipyard Corporation	6	1,500	.....	....	.....	.....	....	.....	.....	....	.....	.....
Southwestern Shipbuilding Company	4	28,500	12,600	....	.....	.....	2	10,388	5,600	....	.....	.....
Spedden Shipbuilding Company	2	1,320	.....	....	.....	.....	1	325	.....	....	.....	.....
Standard Shipbuilding Corporation	4	17,956	9,300	....	.....	.....	....	.....	.....	....	.....	.....
Standifer, G. M., Shipbuilding Construction Corporation	4	48,000	11,200	....	.....	.....	....	.....	.....	....	.....	.....
Staten Island Shipbuilding Company	10	16,349	8,100	....	.....	.....	....	.....	.....	....	.....	.....
Story, A. D.	4	500	100	....	.....	.....	2	510	.....	....	.....	.....
Submarine Boat Corporation	11	24,815	12,800	....	.....	.....	1	3,545	2,000	....	.....	.....
Sun Shipbuilding Company	8	65,227	27,900	....	.....	.....	5	29,010	11,350	....	.....	.....
Tank Shipbuilding Corporation	2	1,250	.....	....	.....	.....	....	.....	.....	....	.....	.....
Texas Steamship Company	2	7,360	3,000	....	.....	.....	1	6,702	3,000	....	.....	.....
Todd Dry Dock & Construction Corporation	1	3,620	2,400	....	.....	.....	....	.....	.....	3	21,300	270,000
Union Shipbuilding Company	2	13,122	6,400	....	.....	.....	2	13,000	6,400	....	.....	.....
Virginia Shipbuilding Corporation	....	.....	.....	....	.....	.....	1	6,060	2,500	....	.....	.....
Vinyard Shipbuilding Company	4	741	1,204	....	.....	.....	2	640	820	....	.....	.....
Vulcan Iron Works, Inc	(6 triple expansion, 6 compound and 2 quadruple expansion engines, with a total horsepower of 18,500.)											
Charles Ward Engineering Works	1	.....	1,800	....	.....	.....	2	660	1,050	....	.....	.....
Winnisimmet Shipyard, Inc	1	772	700	....	.....	.....	....	.....	.....	....	.....	.....
Totals	399	1,140,785	622,494	39	74,448	709,600	129	322,680	155,895	53	460,296	1,876,400

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American Shipbuilding Returns for 1921

Output of Merchant Tonnage Three Times Pre-War Record—Much Repair Work in Sight—Important Developments Looked for in 1922

WHILE the year 1921 will go down in the annals of shipbuilding as one of the lean years when contracts for new construction were few and far between, this does not mean that our shipyards have been idle for the past year. On the contrary, they have produced a total of 1,140,785 gross tons of shipping, which is approximately three times the best record of the years 1900 to 1915 inclusive and which approaches very closely the output for 1916 when the boom due to the war began. Practically all of this tonnage, however, was contracted for in the latter part of 1920.

The falling off of new business in 1921 was not confined to shipbuilding alone but extended to all lines of industry due to the exceptionally unsettled state of the world's markets and the declining volume of foreign commerce.

Conditions were further aggravated by the large number of Government owned vessels laid up and the failure of the Government to adopt a definite policy with regard to our merchant marine.

That officials in Washington at the present time are fully alive to the needs of the world is demonstrated by the initiative shown in promoting the Limited Armament Conference, with a view to lightening the military burden of all nations to the benefit of commerce, and by seriously taking up the question of ship subsidies as a means of placing our merchant marine in a position to meet foreign competition in world trade.

Armament Conference

The limited armament conference now under way in Washington, while at first viewed with alarm by the shipbuilders of the United States, is assuming an aspect which may prove a distinct boom to the merchant marine.

Definite peace arrangements consummated as a result of this International Conference will go a long ways toward stabilizing business all over the world with a resulting increase in foreign trade that will quickly reduce the idle tonnage now gracing so many of our ports. This may be better realized from the fact that, based upon the pre-war rate of increase, there is a deficiency in world tonnage at the present time amounting to some two and a quarter million tons. As trade returns to normal it is evident that this tonnage will have to be made up and this figure will be further augmented on account of a large number of the older vessels being scrapped.

Subsidy

The question of some sort of a subsidy for the American merchant marine to offset the difference in standards of personnel, which exists between the United States and foreign countries, seems very likely to be settled by the early part of 1922.

A special committee of shipowners, operators and builders has been working on a plan for subsidies for several weeks past and President Harding has requested this committee to have its report in his hands by January 1. The President, it was learned, plans to take up the question of ship subsidies in a special message to Congress the first week in January.

The question of a subsidy will open the whole subject of our merchant marine and undoubtedly result in the adoption of definite policies which will stimulate interest and lead to important developments in our water borne transportation systems.

That subsidies were responsible for the success of early American transatlantic lines and also for the present position of pre-eminence of the British steamship lines is shown by Winthrop L. Marvin on page 5 of this issue.

Tonnage Now Under Construction

According to the latest figures available, there are at the present time 322,680 gross tons of steel merchant vessels under construction in the United States. This tonnage, while seemingly low when compared with the record years of the war, exceeds the annual output of any year between 1900 and 1915 with the exception of 1906 when 348,555 and 1907 when 450,017 gross tons of shipping were produced.

Passenger Ships

It has been stated that the United States needs at least one hundred fast passenger vessels to balance its huge fleet of merchant ships.

The present plans of the Government will increase the importance of this class of vessels and, with the adoption of limited armaments and the granting of a subsidy, there is no doubt that a number of vessels of this type will be included in the merchant construction work for 1922.

Repair Work

The large number of idle ships now in our ports is an assurance of busy times ahead for the ship repair yards. Every one of these vessels must be overhauled and reconditioned before again being placed in service. Many will be fitted with new machinery.

The motorship has made an enviable record for economical operation in the months of keen competition just passed and this type of propulsive power will undoubtedly be installed in a number of these vessels.

Conversion of Battle Cruisers

The conversion of the six battle cruisers, now under construction for the Navy, into fast passenger vessels is also gaining favor. These vessels would be scrapped under the armament limitation plan and their conversion would provide a nucleus for a future fleet of passenger ships in addition to offsetting the monetary loss involved. It is estimated that these vessels can be fitted to provide accommodations for from 3,200 to 3,500 passengers in addition to providing for the carriage of at least 2,500 tons of freight. These vessels would provide a nucleus for a future fleet of passenger ships and would undoubtedly be well patronized as affording the greatest amount of safety afloat due to the unusual watertight subdivision of the hull.

Ship Breaking-Up Industry

Another possible development of the Limited Armament Conference will be the establishment in this country of a number of firms for the purpose of breaking up and salvaging material from vessels discarded by the Navy.

This will be a new business undertaking in the United States, and judging from some of the results obtained in Europe is likely to prove a profitable undertaking.

While there has been an expression of pessimism regarding the shipbuilding situation in many quarters, the returns for the year just ended show a gratifying figure for tonnage constructed and the new developments now taking place indicate a normal business for 1922.

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Shipping and Shipbuilding in Great Britain in 1921

By W. H. Wendon

The year which has just closed has been one of keenest anxiety to those engaged in all branches of shipping—whether builders, engineers, repairers, owners or brokers. Following the artificial boom conditions during the period of the war and immediately after, the weak points in the armor of the newly-established companies were clearly shown up, with the result that failures have been frequent. More than that, many companies whose affairs have not already been placed in the hands of a receiver are shivering on the brink of attaining that unenviable distinction.

IT is noteworthy to reflect that the opening of the year 1921 practically synchronized with the dawn of disillusionment in the minds of the majority of those dependent on industry. It was not unnatural, therefore, that, so far as shipowning was concerned, schemes should be mooted having as their object the improving of the freight situation. The most concrete plan, and that which aroused the greatest interest, was propounded in March by Sir Owen Philipps, the newly elected president of the Chamber of Shipping of the United Kingdo ..

Schemes for Improving Freight Situation

Pointing to the fact that at that time there was an excess of no less than ten million tons of merchant shipping as compared with 1914, Sir Owen Philipps urged in no uncertain manner the scrapping of the unusually large number of old vessels of all countries, which craft, owing to their age, construction or design, must be unsuitable to compete in the strenuous times that lie ahead. Sir Owen Philipps further contended that the sooner these obsolete vessels were broken up, the better for all concerned and, in the interests of both shipowners and shipbuilders and their employees, he expressed the hope that the industry of the shipbreaker, which had fallen into abeyance since 1914, would again become active, as otherwise he feared that shipbuilders in Great Britain and abroad would witness a dearth of new orders for some time to come.

Shipbreaking Industry Revived

As all the world knows, this opinion has unfortunately been borne out by events. The keenness of Sir Owen Philipps' view that the older vessels should be sent to the shipbreakers is emphasized by his recent declaration that, in addition to the older vessels, the inferior new ones, built more or less for emergency purposes during the war, ought, in his opinion, to be broken up. The materials of which these vessels consist could, it is true, be made use of in some way or other, but against the adoption of this course there is at present one very real difficulty and that is that the cost of labor for breaking up a vessel often nearly equals the value of the material. But time, the great healer, will probably put matters right in this respect.

Voluntary Laying Up of Steamships

Another great factor in the attempt to adjust the unsatisfactory tonnage position has been the endeavor to formulate some workable scheme having as its object the voluntary laying up of steamships. Notwithstanding the fact that a very large proportion of the tonnage of the world continues compulsorily idle, there is still a great excess over the world's needs. It will be recalled that shortly prior to the war the freight market was flooded with tonnage and a scheme for a reduction in the number of the vessels in commission was formulated and ready for operation. But with the outbreak of war and the universal demand for steamship space, coupled with the enormous losses during the submarine campaign, every ship found its billet and the laying up plan was shelved. The subject came into prominence again in May last at the meeting in London of the Baltic and White Sea Conference. Sir William Noble, the president of the Conference, reminded the delegates that as far back as 1905, during a similar post-war depression, a minimum scale of freights was created. While this scale did not achieve all that was expected, it did arrest the fall and enable steamers to be employed. I mention this as a matter of historical interest, but I would add that, while from time to time during the past year the idea of laying up such a quantity of tonnage as would impel an increase in freight rates has been mooted, shipowners still seem as far off as ever of coming to some practical result.

The throwing on to the market of an immense amount of ex-German steamship tonnage has necessarily created dissatisfaction both among shipowners and shipbuilders. The very fact that about 400 of the ex-enemy vessels allocated to Great Britain have been disposed of should give a vivid indication of the chaos which occurred in the British shipping sale market. During the first nine months of the year shipbrokers were at their wits' ends as to the best means of conducting their business, but towards the close of 1921 "a certain liveliness" was discernible, one firm of brokers carrying through the then amazingly large number of 21 transactions during a period of three weeks.

Which brings me to shipping values. The transactions which have been recorded during the past year have been, to say the least, phenomenal.

Shipping Values

The most sensational deal was undoubtedly that connected with the fleet of the ill-fated Western Counties Company. The history of this concern is, indeed, a remarkable one. Prior to the late boom the company was the modest possessor of a few cargo steamers, but in December, 1919, it acquired the famous Moor Line fleet of thirteen cargo carriers, aggregating 82,000 tons deadweight. Notwithstanding that these boats averaged 11½ years of age, the expenditure of no less than £1,804,000 was required, equivalent to £22 per ton on the vessels' deadweight carrying capacity. In order to provide the funds for this huge purchase, the company increased its share capital from £274,000 to £1,250,000, the balance of the purchase price being secured by the issue of debentures. Within three months of the purchase of the Moor Line boats the Western Counties became the owners of the Sutherland fleet of 11 cargo steamers with an aggregate carrying capacity of 75,000 tons. For these vessels the expenditure of £1,825,000 was necessary. In order to carry through this acquisition, a further £1,000,000 was needed, and, as before, the public responded nobly, the issue being largely oversubscribed. With the crash in freight rates the company failed and in August eight of the boats were sold by order of the mortgagee for £266,150, as against £1,450,000 paid for them in February, 1920.

The Maindy Shipping Company, a Cardiff enterprise similar to the Western Counties, also met with a disastrous result, its fleet of ten steamers being seized by the mortgagees

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in consequence of the company being unable to meet its commitments.

SHRINKAGE OF SHIP VALUES

As being representative of other remarkable shipping sale transactions which have taken place during the past year, mention should be made of the following: The *Michael Bistis,* of 5,850 tons deadweight, built in 1890, changed hands in 1919 for £160,000. In June last the most that could be obtained for her was £4,500. The Commonwealth Government's *Vermont,* of 6,800 tons deadweight, built in 1900, realized £110,000 when disposed of in 1916, and no less than £170,000 in May, 1919. During the past year she was again sold, but on this occasion only £15,000 changed hands. Two of the steamers owned by T. G. Beatley & Son (another firm whose financial affairs have been before the Bankruptcy Court) have provided instances of great depreciation in values. Their *Madame Midas,* of 3,624 tons deadweight, built in 1904, realized £16,750 when sold in December, 1909; £23,000 in November, 1912, and £63,750 in September, 1918. In November last, however, she was put up by auction in London and fetched only £11,350. The *Madame Brooke,* which was disposed of in March, 1917, for £37,500, realized only £9,000 in November last. These instances of depreciation could be multiplied many times, but suffice it that they are indicative of the melancholy state of the shipping sale market during the past twelve months.

EARNINGS OF STEAMSHIP COMPANIES

The earnings of steam shipping companies during 1921 have been on a much lower scale than of late years and, especially in the case of Cardiff companies, dividends have been noticeably attenuated. The position may be gaged from the fact that such efficiently managed companies as the P. and O. and Royal Mail Steam Packet have limited their distributions. The P. and O. was, perhaps, the bigger shock of the two, as it has always been the avowed practice not to distribute more to the deferred shareholders in any one year than can be maintained in future years. In the existing depression, however, the action of the managers is quite understandable and the course they have adopted is, after all, a wise one in reducing the distribution rather than paying more than the company can really afford.

The prices of shipping shares have not unnaturally been affected during the slump and in this connection the following table showing the values of the shares of representative companies in March, 1920, twelve months later and in December last, should not be without interest:

	Nominal value of shares	March, 1920	March, 1921	December, 1921
African S. S. Co.	£20	£33	£21	£23
Argentine Nav. Co.	1	1⅛	½	¼
Cairn Line	1	1¾	15-16	13-16
Clan Line	10	31½	9	8½
Cunard Line	1	2 3-16	15-16	⅞
Furness Withy	1	2⅝	1⅛	1⅛
Houlder Line	5	17	9	9
Indo-China	5	53½	35	33¼
Khedivial Mail	1	5½	5½	5½
King Line	1	2	1⅛	1
Orient Line	5	20	7½	9
P. and O. Co.	100	560	320	282
Royal Mail S. P. Co.	100	195	90	78
Anglo-European Co.	1/—	7/6	9d.	1½d.
Australasian United Co.	£50	£30	£40½	£40½
Britain S. S. Co.	10	46⅛	20½	20⅜
Canada Steamship	100	80	35	21
Court Line	20/—	44/—	28/1½	25/4½
Cressington Co.	20/—	42/—	26/—	27/1½
London-Am. Maritime Co.	20/—	36/3	16/—	16/—
Western Counties Co.	20/—	22/—	5/—	½d.

Theft and pilferage have been the subject of keen discussion throughout the whole of 1921 and great steps forward have been made in eradicating this world-wide evil. The policy of imposing a fine on the offender has been proved repeatedly to be of no deterrent value. The infliction of a sentence of imprisonment is the only effective manner of dealing with the miscreants.

MINISTRY OF SHIPPING ABOLISHED

The Ministry of Shipping came to an end during the past year. During its lifetime it was responsible for ordering 821 vessels in the United Kingdom and abroad; 279 of these were transferred to private owners for completion, the orders for 126 were cancelled, involving an expenditure by way of compensation of £500,000, and the remaining 416 boats were completed. Twenty-three of the latter were sunk, 15 were transferred to the Admiralty service as oilers and the balance of 378 were sold to private owners.

The total cost of the 228 ships built in this country was £36,481,000 and the selling price £47,591,000, showing a profit of £11,110,000; 122 ships built abroad cost £26,884,000 and were sold for £18,289,000, or a loss of £8,595,000, the net profit on the 378 ships being £2,515,000. If, however, 5 percent depreciation had been allowed, the net profit would have been increased from £2,515,000 to £5,122,000, while if a similar number of ships had had to be ordered from neutrals, it would have entailed an additional expenditure of £27,000,000.

There were larger receipts from the liner requisition scheme to the extent of £11,000,000, additional earnings of ex-enemy ships amounted to £9,600,000, and a further £579,000 was received from miscellaneous receipts, sales, etc. Recoveries from Allies, Dominions and trading developments totaled £13,250,000, sales of ships £1,680,000, and sales of shipyards and materials £70,000.

It will be gathered from the foregoing that the Shipping Controller's Department resulted in a substantial profit to the State.

ORDERS FOR NEW SHIPS LACKING IN 1921

One of the most melancholy features of the shipbuilding and engineering trades in the past year has been the almost complete absence of new orders. Most of the yards have been pretty well occupied, but this activity is only traceable to the working off of the orders contracted many months ago.

The strike of shipyard joiners was particularly disastrous. The cessation of work commenced as far back as August, 1920, when the whole of the shipwrights employed in repairing on the Mersey struck work, without the authority of the executive of their trade union, to enforce the demand for a minimum wage of £6 a week. They eventually returned to work without gaining their object but, in the meantime, the loss of 400,000 working hours had taken place and the direct result of the men's action was to divert many important contracts to foreign countries. On December 1, 1920, the men again struck and then for many months the ship joinery industry of the country was in a state of chaos. Messrs. Cammell, Laird & Company, to mention one firm only, lost something like 700,000 working hours in consequence of this long drawn out dispute.

WATERTUBE BOILERS FOR MERCHANT VESSELS

The suitability of watertube boilers for all classes of merchant vessels was given a good deal of prominence during the past year by the leading technical authorities. Sir James Kemnal raised the matter by reading a widely discussed paper before the North East Coast Institution and the subject was taken up by Mr. Waldie Cairns, who intimated that if ships sailed in good boiler water he might fit nothing but watertube boilers. For ships with high power of a large number of boilers—even sailing salt seas—he would consider watertube boilers favorably; but for moderate powered ships with, say, up to the equivalent of four large cylindrical boilers, he would like to know a good deal more about actual

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performances before recommending steam generators of the type.

He adopted this standpoint mainly on the question of the weight of water in the system. In a ship of moderate power the weight of water had two rather important functions. A good weight of boiler water acted, for instance, as a "thermal fly-wheel," levelling up some of the inequalities in firing and fire-cleaning, which were very appreciable in moderate powered ships. The other function of a good weight of water was the capacity to take up, without rapid development of trouble, such quantities of sea water as might leak into the system from failure of a condenser tube or a condenser tube packing, which, even if detected, could not always be remedied quickly.

Taken all in all, Mr. Waldie Cairns is of opinion that there is good reason for caution. Moreover, bearing in mind the extra 100 tons deadweight capacity which Sir James Kemnal had indicated for a boat of 2,000 horsepower, this, Mr. Waldie Cairns believes, is not a great matter compared with the elasticity, handiness and general reliability of the old cylindrical boiler.

New System of Construction for Oil Tankers

Another technical feature of the past twelve months has been the adoption of a new system of construction in relation to oil tankers. The difficulty with which shipbuilders are confronted in building this type of vessel is to make a good connection of the centerline and the thwartship bulkheads, the present arrangement being expensive and altogether unsatisfactory. The new system referred to is claimed to achieve a perfect joint at a lower cost. It consists of a vertical plate lapped on the center keelson and extending to the oil deck with two tee bars, one on either side. The tee bars extend from keel bar to oil deck and form a "cross section" to which the horizontal plating of the centerline and transverse bulkheads is connected. This "cross section" forms a metal-to-metal joint, dispensing with the injection of cement or other substances.

It is claimed that by its use (1) all difficult riveting is eliminated; (2) three-ply riveting is reduced by 50 percent; (3) calking is reduced by 50 percent; and (4) the cost of erecting is reduced. The structure is so light that it can be erected with ordinary facilities. The bulkhead stiffeners and knee connections can be hydraulically riveted to the bulkhead plating on the ground before erection, leaving only the seams of the bulkhead plating to be riveted in position.

Another advantage is that the narrow plate, fore and aft, connected to the longitudinal bulkhead plating by a double-riveted lap increases the strength of the centerline bulkhead—which is, of course, of very great importance in oil carrying vessels in order that they may withstand the hogging and sagging stresses to which they are subjected.

Harland and Wolff's Increased Facilities

A mild sensation was created towards the close of the year when it became known that the great shipbuilding and engineering firm of Harland and Wolff, which already possessed yards at Belfast, Glasgow, etc., had undertaken a great repairing contract at the Port of London. It is noteworthy to recall that many years ago the shipbuilding and repairing yards of the Thames were one of its "glories," but one by one the companies were weeded out until only the smaller firms remained. However, Messrs. Harland and Wolff now have in their possession the right to do all the repairing and maintenance work required by the Port of London Authority and are under obligation to spend at least £300,000 in bringing the plant up to date. Despite the depression existing in all branches of the industry, Messrs. Harland and Wolff are making progress with their latest acquisition.

In regard to new vessels, on which subject many columns of this journal might be occupied, particular interest, perhaps, attaches to the twin screw Anchor Liner *Cameronia*, the first large liner to be laid down and afloat after the armistice, inasmuch as her launch in the remarkably short period of 9½ months from the laying of the keel constituted a record in British shipbuilding.

New Ships

The *Cameronia* represents a new type of intermediate Atlantic liner, embodying all the features hitherto exclusively found in "ocean greyhounds" and propelled by machinery of the most recent type, calculated to give the maximum economy of operating cost under all service conditions. The propelling machinery, supplied by Messrs. Beardmore, also the constructors of the hull, consists of two sets of Brown-Curtis turbines, each comprising one high pressure, one intermediate pressure and one low pressure turbine, astern turbines being incorporated in each intermediate and low pressure casing. The machinery develops at full power 13,500 shaft horsepower, sufficient to maintain a speed of 17 knots in moderate weather.

Both from shipowning and shipbuilding points of view, the formation of a company called the "British Trade Ship, Limited," with an unusually influential board of directors, was an outstanding event of the year. The object of the promoters of this scheme was to construct an exhibition ship *par excellence* and, if the indications are trustworthy, those responsible for the vessel will achieve at least this part of their program. The boat is now building by Messrs. Swan, Hunter and Wigham Richardson, Ltd., who are largely interested in the scheme. The intention is to send the vessel to the chief ports of the world in 1923 as a method of attracting business of all descriptions to commercial centers in the British Empire. The boat is to have a gross tonnage of 20,000 and a length of 550 feet, her extreme breadth will be 74 feet 9½ inches and her depth, molded, 44 feet 6 inches to the shelter deck. Her cruising speed in exhibition trim will be in the neighborhood of 12½ knots.

International Shipping Conference

In view of the complex problems which have confronted shipowners during 1921, it was not unfitting that a great International Conference, in which American delegates took a prominent part, should be held in London towards the end of the year. The leading questions of the day were discussed at length, and some momentous decisions were arrived at. The matters dealt with included the much discussed Hague Rules, the load line regulations, the carriage of wood cargoes on deck and the safety of life at sea. In regard to the last-mentioned, general satisfaction is expressed in responsible shipping circles in Great Britain that at last a serious attempt is apparently to be made to revise the Maritime Convention of 1914, a measure which has been postponed regularly at intervals of six months, and at the moment is under postponement until July 1, 1922. In the light of the experience gained during the war, it is not too much to hope that practical results will be forthcoming in the near future.

Another matter of world wide interest which has come into special prominence in the past year has been in regard to the dangers arising from floating oil in harbors and docks. After serious consideration of all the difficulties attending this important question, a representative meeting of shipowners agreed that it was essential in all cases that the provision, either directly or by contract, of barges or other convenient receptacles by the port authorities should be compulsory. For a long time there was disagreement on this point between shipowners and the dock and harbor authorities, but eventually the latter agreed that, although they could not submit to a statutory obligation to provide suitable receptacles, they would in fact do so at all ports where such receptacles were necessary. The shipowners accepted this compromise and it is more than probable that much good in regard to the modification of the floating oil evil will result.

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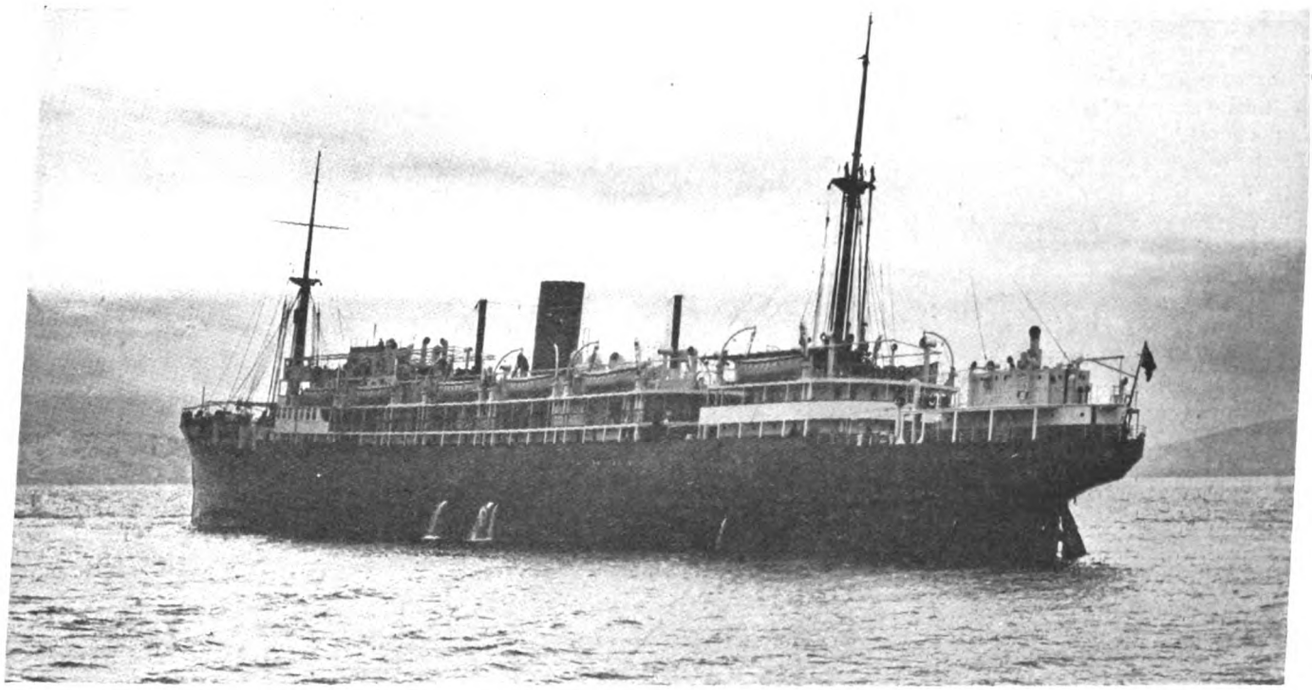

Motor Passenger Liner Aba in Belfast Harbor

The First Motor Passenger Liner

The Aba of 8,000 Gross Tons and 6,400 Indicated Horsepower Assigned to Liverpool-Africa Route

By A. P. Chalkley

THE motor cargo ship has now become so common that new vessels fitted with oil engines attract comparatively little attention. Passenger liners, however, come within a different category and it is natural that the first vessel of such a class should arouse unusual interest among the shipping community.

To the well-known shipowners, Elder Dempster and Company, Liverpool, belongs the honor of placing the first motor passenger liner into regular service, the new vessel, the *Aba*, having sailed from Liverpool to Africa on her maiden voyage on November 16, 1921. This is a development of the greatest importance, for although she is not of the dimensions and speed of the large, modern transatlantic liner, the *Aba* is a comparatively large vessel as the following details will indicate.

Length, between perpendiculars	450.5	feet
Breadth	55.8	feet
Depth	36.6	feet
Gross tonnage, about	8,000	
Indicated horsepower	6,400	
Speed, knots	14	
Passenger accommodation (first class)	220	
" " (second class)	105	
" " (third class)	35	

The *Aba* was built in 1918 by Barclay Curle and Company on the Clyde as a cargo vessel, being then the *Glenapp*, and was in service for some months before her new owners, the British and African Steam Navigation Company (for whom Elder Dempster and Company are managers) placed her in Harland and Wolff's hands for conversion to a thoroughly up-to-date liner suitable for the regular passenger trade, the cargo capacity being cut down to 1,000 tons. She would have been completed many months ago had it not been for the prolonged delay to all vessels of this type caused by the joiners' strike at all British shipyards.

The Machinery

Before dealing with the passenger accommodation, which is equal to that of any transatlantic liner and contains many interesting novelties, a description may be given of the propelling and auxiliary machinery. The total power of the two main engines is 6,400 indicated horsepower, which is greater than that of any motorship afloat except for two motor cargo boats, the *Glenogle* and the new *Glenapp* owned by the Glen Line, in which engines of the same designed output are fitted. The motors in the *Glenapp* are of the Burmeister and Wain type and were built by Harland and Wolff of Glasgow. They each have eight cylinders, 29½ inches in diameter with a stroke of 43 5/16 inches, full power being produced at 120 revolutions per minute.

Burmeister and Wain engines are so well known that a few brief details of the design will suffice. It may be added that in general principle of construction, apart from the higher power and increased number of cylinders, they resemble fairly closely the machinery of the *William Penn*. They are of the four cycle type with the usual inlet, exhaust and fuel and starting valves, located in the cylinder covers, operated by long push rods which derive their motion from a camshaft, arranged about half way between the engine room floor and the top of the cylinders. On the camshaft are two side-by-side cams for ahead and astern running respectively. The reversing mechanism con-

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trolled by a lever at the starting platform is so designed that when it is put into motion, by the reversing lever, it causes the push rods to be lifted off the cams, the camshaft to be moved, so that the astern cams come below the levers, and finally the push rods again to be brought into contact with the cams.

STARTING MECHANISM

Unlike most Diesel motors, the engines are each provided with two three-stage air compressors, supplying blast injection air at about 1,000 pounds per square inch while the starting air pressure is 360 pounds per square inch. Most of the other main engine auxiliaries are, however, separately driven by electric motors, except the eight small fuel pumps. After the reversing lever has been operated so that the valve gear is in the correct position for ahead or astern running as the case may be, the engine is started up by the movement of a single starting lever which admits air to the cylinders through the starting valves. The same lever also turns the cylinders over to fuel and speeds up the engine, thus giving a very simple control.

NEW FEATURES OF DESIGN

There are one or two points in the design of the motors, which, so far as the writer is aware, have not been adopted previously on Burmeister and Wain engines.

Some of the cylinder covers have been made in two sections, the lower portion alone being subjected to a very high temperature. This section is spigotted into the upper part containing the valves. The object is that, should a crack develop, it will arise in this lower portion which can thus be more readily and cheaply renewed than if a whole cylinder cover had to be replaced.

A second important innovation lies in the construction of the pistons. Between the outer part of the piston, in contact with the liner, and the inner part, which is water cooled, there is an annular space around which air is allowed to circulate. The effect is a combination of water and air cooling which it is understood provides a better design than the usual system which is wholly water cooled. As is common practice with Burmeister and Wain engines piston cooling is effected by fresh water, a supply tank being arranged below the engine room floor. This piston cooling water circulates around a sea water cooler of moderate dimensions, but the cylinder jackets are supplied by sea water.

The spares carried for the main engine comprise two covers, two pistons, various valves and a number of minor accessories.

ELECTRICAL AUXILIARY MACHINERY

As might be anticipated in a modern motor passenger liner, steam driven auxiliaries in the engine room and on deck are notable by their absence. A very small donkey boiler of the Cochran vertical type indeed comprises the whole steam installation, the object of this being for the provision of steam to the thermo tanks on deck by means of which hot air is supplied to the cabins and the dining saloon when the ship is in a cold climate. The only steam driven auxiliary is a small air compressor fitted only for emergency.

The electrical installation is very complete, as may be gathered from the fact that four electricians are carried. On deck are ten electric winches, an electric windlass, half a dozen electric exhausting fans and an equal number of variable speed electric motors driving fans in connection with the thermo tanks for the supply of warm air or fresh air to the cabins as required, this is delivered to a series of ducts, arranged with louvres in all of the cabins as well as the dining saloon. Electricity is used throughout the galley for cooking, while the bakery and the laundry are also supplied with electrically operated machines, even such details as the knife cleaning and boat cleaning machines being coupled to electric motors.

Apart from the thermo tank system of heating previously referred to, the main saloons are supplied by a new form of electric vapor heater which is used in connection with the electric plugs, in a similar manner to the normal electric radiator. The method of operation is, however, different, for the electricity is utilized for raising steam in a self-contained steam radiator. This is a new system which is now adopted for the first time and which it is believed is specially applicable to motorships where electricity is employed to such a large extent.

In the engine room a very large number of electric motors is required. The main auxiliary compressor, of which only one is installed instead of the usual two, is a three stage air high pressure machine driven by an 80 horsepower motor. The piston cooling pump is of the reciprocating type driven by a motor of 10 horsepower while for lubricating there are three electrically operated gear pumps. Salt water circulation for the cylinder jackets is effected by two electric rotary pumps, while the bilge pump, general service pump, fuel pump, turning gear and the DeLaval oil separator are all driven electrically. A large refrigerating plant has been installed of the CO_2 type and this comprises duplicate compressors and brine pumps.

Generally speaking when the ship is at sea, it is estimated that 300 kilowatts will be required and sometimes more. The electric generating plant is therefore on a large scale and there are three sets installed each with an output of 300 kilowatts driven by a four cylinder Harland and Wolff Diesel engine of 320 brake horsepower running at 210 revolutions per minute. The power is delivered to a very large switchboard at 220 volts and this pressure is used throughout the ship, not only for power but for lighting purposes.

FUEL CONSUMPTION

The fuel consumption of the ship is estimated at 20 tons per day which compares very favorably with 90 tons of coal required on a corresponding coal fired steamer and some 50 or 60 tons of oil which would be needed on a vessel equipped with oil fired boilers. The fuel tanks between the shaft tunnels have a capacity of 750 tons—sufficient for a voyage of 37 days' duration at full speed—and as on the round trip the vessel will be under way only for about 30 days there is ample bunker capacity for the whole voyage from Liverpool to West Africa and back.

PASSENGER ACCOMMODATION

The aim of the builders and owners has been to provide passenger accommodations equalling in luxury and comfort that which is obtained on the finest liners crossing the Atlantic.

The first class dining saloon which seats 220 passengers at small tables is arranged on the main deck right forward and occupies the whole width of the vessel, its height in the center reaching to the shelter deck. It is finished in white with gilt decorations and wedgewood placques somewhat in the Adams style, the furniture being of oak. On the same deck is the galley, bakery and all cabins required in connection with the supply of food while at the after end is the second class dining saloon seating about 100 people.

The other first class public rooms are all on the bridge deck comprising a first class lounge forward, a reading and writing room, and a smoking room right aft. The lounge is panelled in sycamore with carving and is fitted with wicker chairs with tapestry cushions while a piano is provided. The reading and writing room is painted grey and has a number of mahogany writing tables, the chairs and small tables being of wicker, while tapestry cushions are used throughout. The smoking room is of oak and like the lounge has an attractive electric fire with a tapestry panel above. Aft of this smoking room is an open air veranda and on the same (bridge) deck are two special suite cabins

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Interior Views of Motor Liner Aba

(1) First Class Reading and Writing Room; (2) First Class Dining Room; (3) First Class Smoking Room; (4) First Class Lounge; (5) Forward End of Engine Room, Showing Lubricating Pumps for Main Engines; (6) Starboard Side of Engine Room, Showing Auxiliary Generating Sets; (7) Top Platform, Showing Rocking Levers on Main Engines; (8) Lower Platform, Showing Maneuvering and Reversing Gear.

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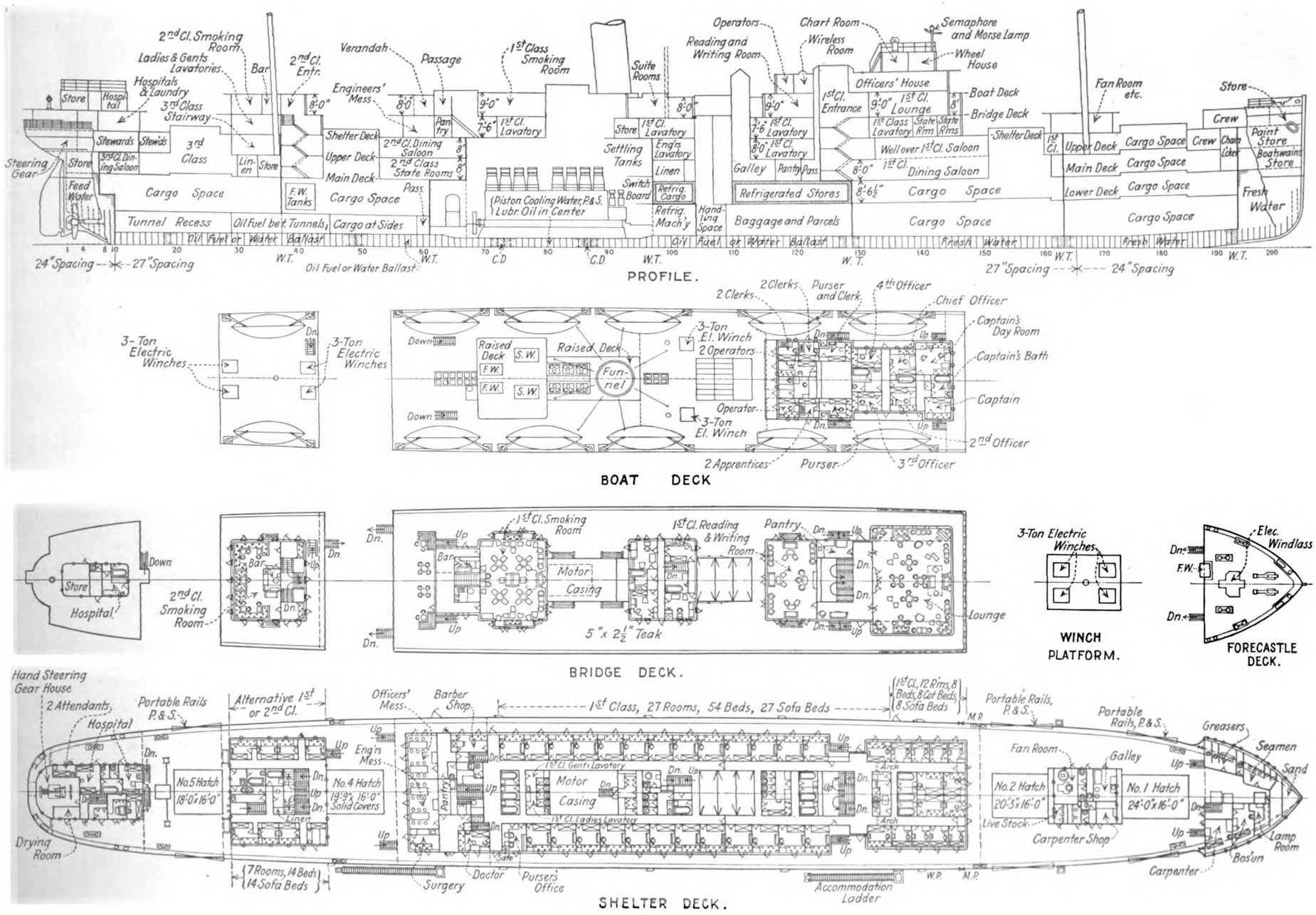

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Profile and Deck Plans of Motor Passenger Liner Aba

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comprising a very large sleeping cabin and a sitting room, one furnished in oak and the other in mahogany.

The first class staterooms are all arranged amidships and are divided among the upper and shelter decks, arrangements being made for each to have its own port hole, this applying also to the second class cabins. Most are of the two berthed type but some are single berthed cabins with cot beds. The furniture is of mahogany and each first class cabin has a rug and is of unusually large size with a settee besides the two berths.

The arrangement of the cargo holds is clearly indicated on the drawings but special attention may be drawn to the fact that there are three insulated cargo spaces for the transport of refrigerated cargo. These are in addition to the numerous refrigerating chambers for the food consumed on the ship. 4,000 tons of cargo are carried.

In every respect, the *Aba* is one of the most interesting ships that has ever put to sea, and it is understood that the owners contemplate the construction of still larger motor passenger liners.

The Sun Shipbuilding Company's New Dry Dock

Forty-Two Ships Docked During First Six Months of Operation, Averaging One Vessel Every 3½ Days

THE Sun Shipbuilding Company, although but five years old, has already established a record which places it high on the list of efficient shipyards and its advance into the ship repairing field last year has been attended with the same success that has placed it among the leading ship construction yards.

In 1920 the directors of this organization adopted plans for improvements to the plant with a view to broadening its activities to include general ship repair work. The prime requirements necessary to accomplish these results were a dry dock and wet basin of sufficient size to handle the majority of the vessels comprising the world's merchant fleet. A 10,000-ton dry dock, located at the head of a wet basin 960 feet in length with a mean average depth of 40 feet and a width at the river of 385 feet was decided upon as fulfilling the above requirements.

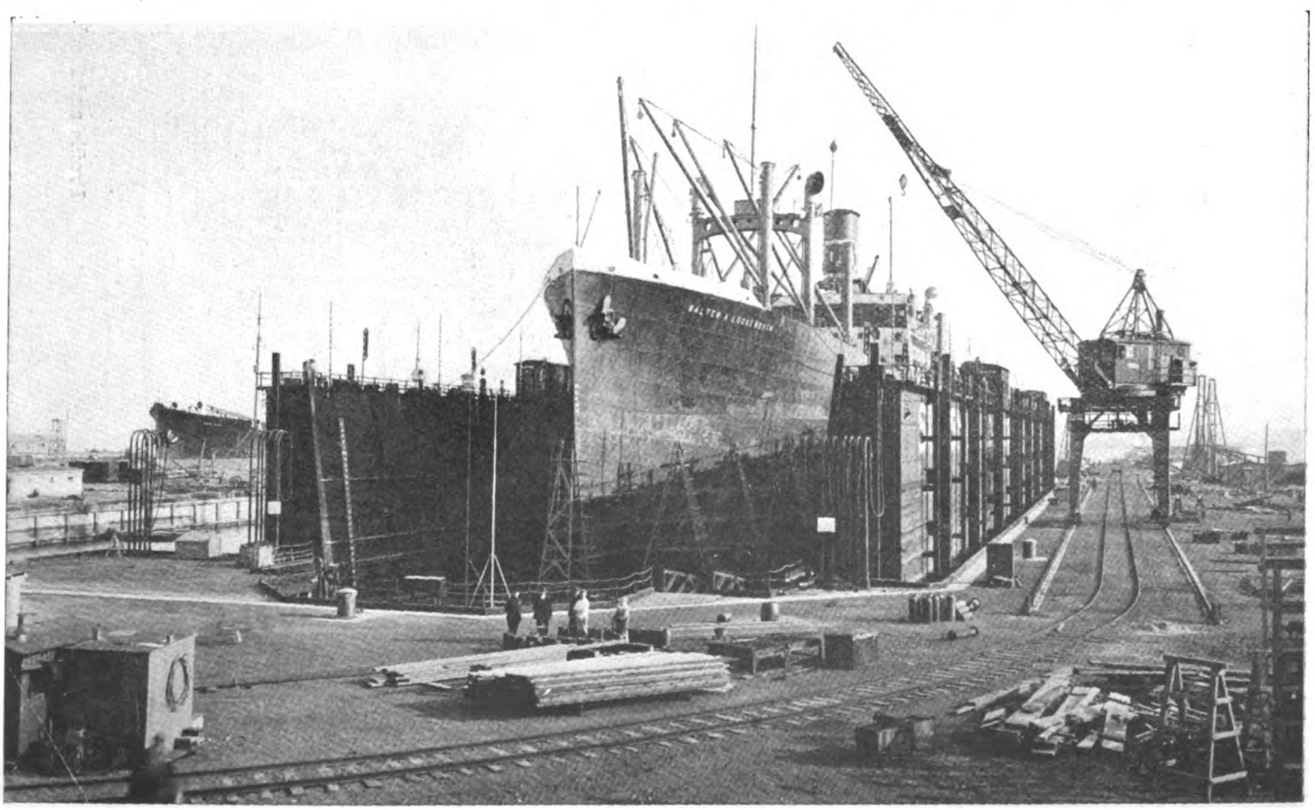
Dredging for the wet basin was started on July 8, 1920, and on December 1, 1920, work was started on the first pontoon for the new dry dock. On June 11, 1921, the new basin and dock were placed in commission and later in the day the first vessel, the Sinclair Navigation Company's tanker *Joseph M. Cudahy,* 10,600 deadweight tons, was docked.

Since then to December 1 no less than 42 vessels have been docked for painting, cleaning or bottom repairs, making an average of one vessel every 3½ days.

The Dock

The dry dock is of the floating type designed by William T. Donnelly, consulting engineer, 17 Battery Place, New York.

The general design consists of wooden pontoons of heavy spruce timber and continuous steel wings in accordance with the well known Donnelly methods of dry dock construction. An innovation, however, has been incorporated in the Sun dock in that it has been constructed in two sections.



View of Wet Basin at Sun Shipyard, Showing New 10,000-Ton Floating Dry Dock in Operation

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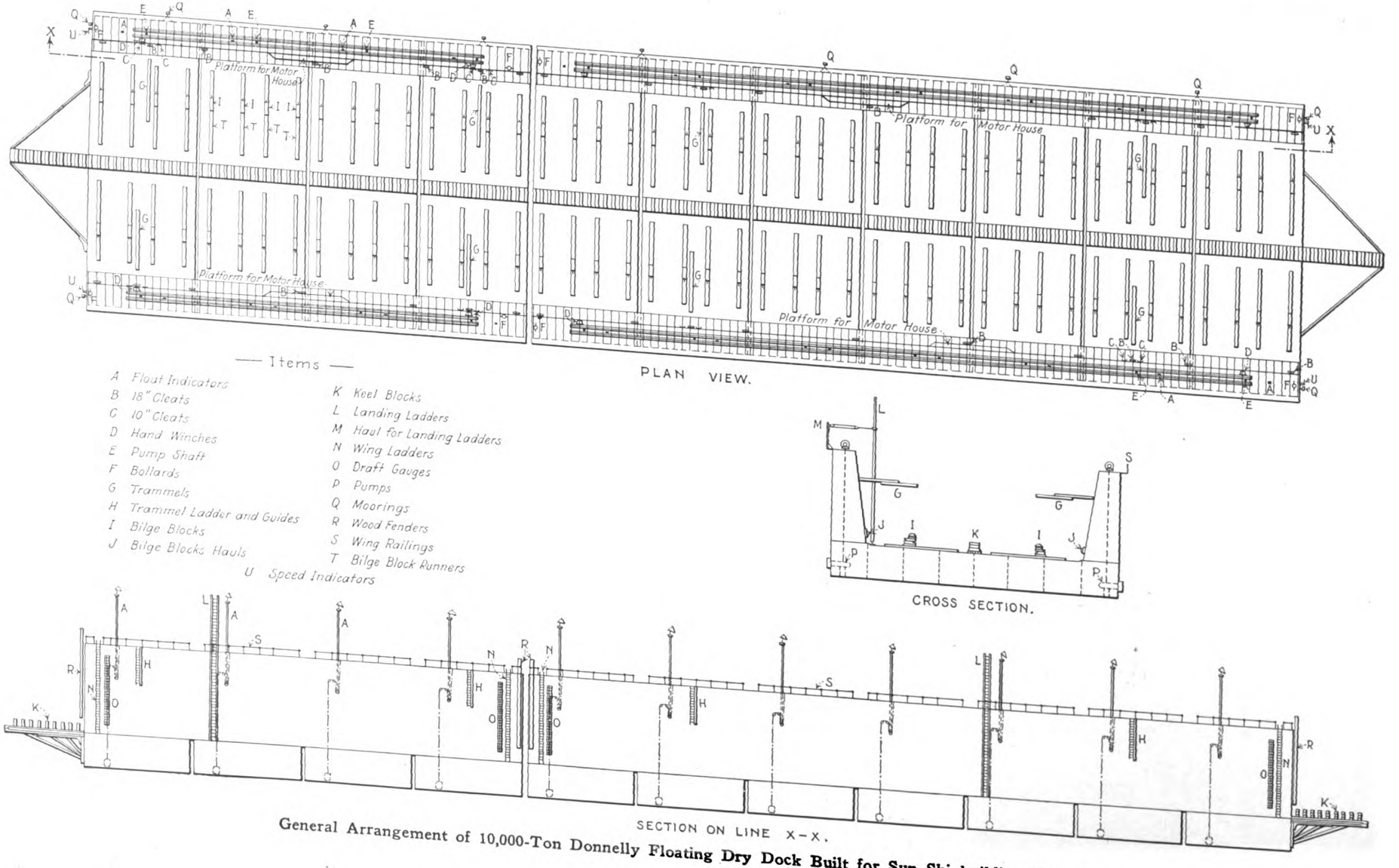

General Arrangement of 10,000-Ton Donnelly Floating Dry Dock Built for Sun Shipbuilding Company

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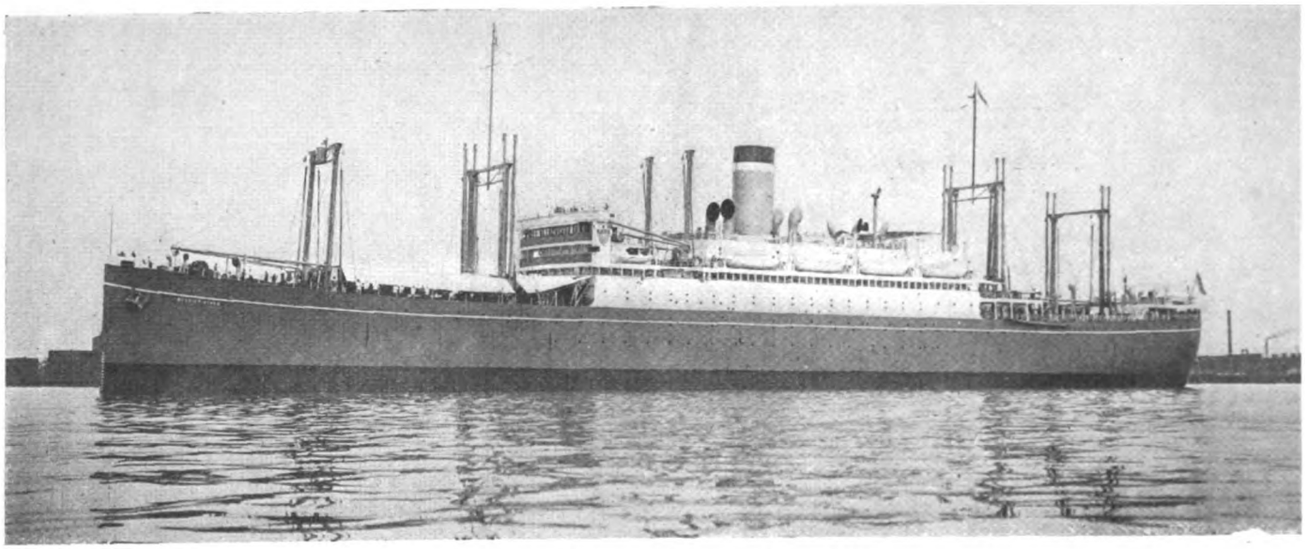


Passenger and Cargo Steamer Hoosier State

The first section, made up of 7 pontoons, is 323 feet long over the outrigger and the second section has 4 pontoons and a length of 197 feet over the outrigger.

Each section is a complete dock in itself and may be used independently of the other, the larger section having an actual lifting capacity of 6,400 tons and the smaller a capacity of 3,600 tons.

Sections Can Be Combined

Provision is made for tying the two sections together to form the big dock with a length over keel blocks of 522 feet 6 inches, a width over all of 110 feet and a rated lifting capacity of 10,000 tons. The dock is capable of exceeding this, however, and has an actual maximum lifting capacity of 11,000 tons. This will allow for docking a vessel of a maximum length of 560 feet, breadth of 78 feet and draft of 23 feet.

Each pontoon is 110 feet long, 41 feet wide and 13 feet 5 inches deep.

The wings are of steel construction 13 feet wide at the base and 35 feet high, topped with a working platform 10 feet 6 inches wide extending the full length.

Operation

The dock is operated by electricity.

In the bottom of each pontoon there are two 12-inch centrifugal pumps, one on each side. From each pump a shaft extends to the top of the wing and by means of miter gearing is connected to a shaft running the full length of the wing. This shaft on the top of each wing is geared to a driving motor located in a motor house at the center of the wing.

There are two motors for each section, one on each wing. The pumps in the large section are driven by two 200 horsepower motors and those in the small section by two 125 horsepower motors. Current is supplied from a station on shore and the operation of the dock is controlled from a house on shore designed to permit a clear view for the operator while docking and undocking ships.

Cables are also led from the control house and run on both sides of the wet basin, with outlet boxes located at intervals of 75 feet, from which current for temporary power and welding may be taken.

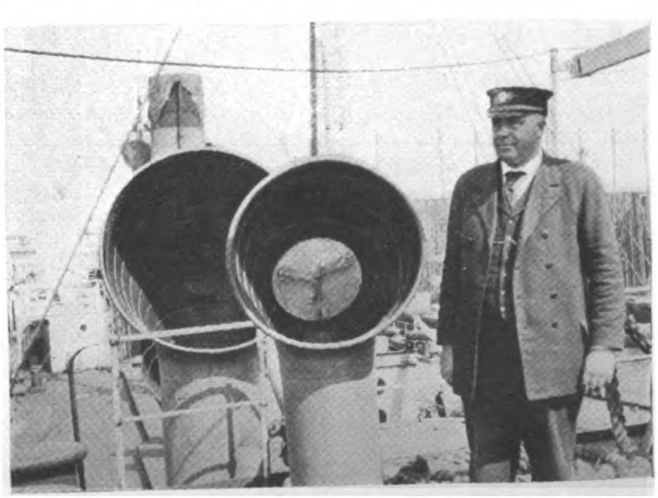
The new Sun dry dock fills a long felt need for such a dock on the Delaware River and the ports of Philadelphia and Chester. It was constructed in six months and eleven days, a record for this size dock and from present indications it bids fair to establish a record for operation as well as construction.

Passenger and Cargo Steamer Hoosier State Delivered to the Pacific Steamship Company

ANOTHER of the 535-foot Shipping Board passenger and cargo vessels has been delivered by the New York Shipbuilding Corporation, Camden, N. J. This is the *Hoosier State* which ran her trials on September 15 and has been assigned to the Pacific Steamship Company for operation. The vessel measures 535 feet overall and has a beam of 72 feet. She is equipped with twin turbines of 12,500 horsepower which will give her a speed of 17½ knots. Accommodations are provided for 280 first class and 194 third class passengers, in addition to a crew of 198 officers and men.

New Type Control for Ships' Ventilators

A RECENT invention for closing and opening ships' ventilators has been perfected and patented by the Ventilator Cap and Cowl Cover Company, Seattle, Wash. It is claimed that but seven seconds is required for capping and plugging one ventilator, and with the services of but one man the full complement of ventilators on an



Ventilator Cap Hanging in Cowl Ready for Instant Adjustment, Closing Vent Water and Air Tight

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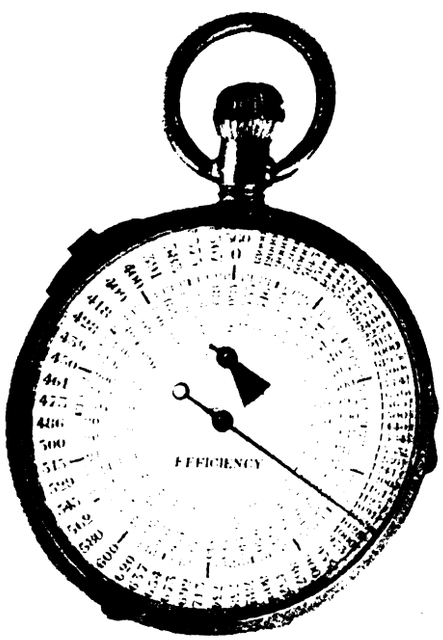
average size ship can be capped and plugged in fifteen minutes. In conjunction with the steam smothering lines, which are led into the holds for fire protection, the ventilator caps are useful, since the ventilators can be plugged quickly and thus allow the steam to produce a smothering effect almost immediately. Ventilation is necessary in cargo vessels to prevent sweating and damage from other causes, and with the new plug advantage can be taken of all favorable weather because it is possible to close the ventilators quickly at a change of weather.

It is stated that the cost of installation of this capping device while it is of a permanent nature is merely nominal, and the Ventilator Cap and Cowl Cover Company is planning to introduce this equipment through ship repair plants at the more important ports in the country.

Duration Time Watch for Studying Efficiency

For the purpose of facilitating the timing of industrial operations, the Mortimer J. Silberberg Company, 122 South Michigan Avenue, Chicago, Ill., has perfected an instrument designed to handle the timing of from one to ten production motions, up to five minutes in duration.



New Type Time Study Watch

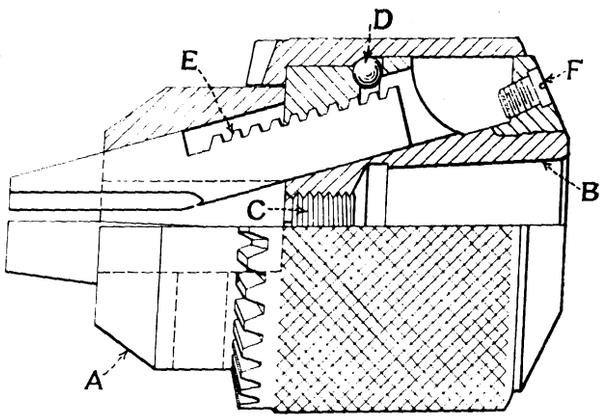
The instrument has three circles on the face of the dial, the outer circle being in red, the center circle in black and the inner circle in blue. The large hand makes a total revolution of 100 seconds, and the small hand in the center moves over a red, black and blue sector, thereby showing in which circle the large hand is operating.

All of the figures on the face of the dial denote production per hour, based on the timing of 10 operations. For example if 10 operations were observed to have elapsed in 20 seconds the figure under the large hand in the red circle would show 1,800 operations per hour, based on 10 operations having been completed in 20 seconds. If instead of 10 operations, one operation is observed to have lasted 20 seconds, then instead of 1,800 it would be necessary to point off one figure with a decimal, and the result would be 180 operations per hour, based on one operation being completed in 20 seconds.

If an operation is timed and its duration is 130 seconds, it will be noted that the large hand will have made one total revolution, and thirty seconds additional, and the small hand in the center of the dial will have passed the first sector, and show in the second sector, which is the black, and which denotes that the operation must be read in the black circle; and reading under the 30-second mark in the black circle the figure 277 will be noted. However, this figure being based on the observation of 10 operations, and only one operation having been timed in that period, it is necessary to point off one figure, and the result is then 27.7 operations per hour, based on one operation timed in 130 seconds.

Toothed Key and Sleeve Type Chuck

THE chuck of the toothed key and sleeve type manufactured for the past eighteen years by the Jacobs Manufacturing Company, Hartford, Conn., has recently been redesigned so that the proportions of the parts now make it more adaptable for general service. The body A is made of steel of a special analysis, deeply case hardened. Through a special process in this heat treating the taper hole B is left soft, fitting it for use on a hardened and ground arbor. This taper hole is ground with great accuracy. A hole is drilled and tapped through the center of the body and fitted with a threaded plug C which may be removed with a screw driver if it is desired to insert rods or other material through the chuck. The taper hole on the chuck is of the same dimensions as those of previous designs. Each of the new chucks has been designed to meet the changed drilling methods of the last few years with relation to design, weight and capacity, all needless weight having been eliminated.



Jacobs Toothed Key Type Chuck

Ball bearings D inserted between the nut and the body reduce friction to a minimum making it possible to machine the thread E on the nut and the jaws with a coarser pitch than heretofore. Reduction of friction makes it possible to tighten the chuck with great ease, preventing undue wear on the keys, sleeves and other parts of the chuck at the same time giving greater gripping qualities.

An oil hole F inserted in the upper end of the chuck makes it possible to lubricate all of the working parts. One half the pressure on the key in tightening the chuck will produce the same results as in chucks of the previous design and the change in pitch of the thread on the jaws has resulted in reducing by one half the number of turns of the sleeve necessary to tighten or loosen the chuck.

Senate and House Committees Plan Joint Meetings

THE Senate committee on commerce and the House committee on merchant marine and fisheries have planned for a series of joint meetings at which officers of the Shipping Board and of the Emergency Fleet Corporation will be heard. Chairman Lasker has already appeared at one or two such meetings, which are held in executive session, and in a way they are a substitute for the general Congressional investigation of Shipping Board affairs which have been several times proposed.

W. J. Love, vice-president of the Emergency Fleet Corporation, has decided to lay before the Shipping Board for action the practice of steamship companies in the Intercoastal Conference cutting rates below those agreed on in conference.

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Design and Construction of Passenger Steamers*

Summary of Problems Confronting the Designer of a Modern Liner — Details of New American Passenger Ships — Standardization

By E. H. Rigg†

THE great problem of today is to design and build ships that can be made economically satisfactory. We are still short of passenger ships; the lack of new orders and holding up of old ones is solely due to economic conditions, high first costs and inability to pay the rates necessarily asked, chiefly the former.

The large number of our recently completed passenger ships which have gone or are about to go into Pacific Ocean trade calls for comment. Of the sixteen 535 footers and the seven 522 footers, representing a gross tonnage of some 300,000, twelve of the larger and three of the smaller have gone into service on the Pacific; of the larger, two are still to be allocated, which indicates that the fleets to which allocations have been made are temporarily satisfied. The Pacific thus gets 67 percent of the tonnage, and there are other indications that our Pacific trade will be large—our interest in China and its development, our nearness to her markets compared with Europe. The Philippine and the Hawaiian Islands make for commerce with the Pacific coast; our Australian and Japanese trade also calls for passenger and freight services.

Then, too, South American trade presents an opportunity awaiting revived foreign trade, improvement in the exchange rate from the foreigners' point of view, improved exporting methods on our part and the working out of the recent foreign trade financial legislation.

Passenger Steamers for Sheltered Waters

Perhaps nowhere in the world are there such opportunities for lake, bay, sound and river navigation as in America. The problems are not as complicated as are those of the ocean; draft is usually limited, and lines adapted for high speed in shoal water are not the same as for deep water. Ports are closer and bunkers carried are lighter; fresh water from overboard is often available for boilers, if not for drinking. Cargo is generally carried in relatively small amounts, largely on deck rather than below. Fire risks are severe in these ships and must be seriously studied and minimized. In rivers and canals, bank erosion must be guarded against, and here the experimental tank has come to our aid in studying wave making. In some recent Hudson river vessels, in particular, wave making has been notably reduced, enabling greater speed to be maintained for the same erosive action or less of such action for equal speed.

Many of these vessels in the past have been built with too little beam for satisfactory stability results; top decks have been increased or added in order to crowd on more passengers, the accident point having been found in more than one instance, notably the *Eastland,* in recent years. Some river steamers have found it necessary to set back the rails, thus limiting the passengers who can crowd top decks; also in boats traversing water with points of interest first on one side, then on the other, water ballast chambers in the wings have been fitted so that the engineer can fill the same on the off side and empty it again after passing the particular point.

Paddle-wheel propulsion still holds its own for this type; the experimental tank is invaluable for correctly locating the wheel center to avoid disaster due to wave profile and wheel not meshing.

Paddle wheels have been recently severely put to it to hold their own with screws working in tunnels as a means of propulsion for shallow draft vessels. We have also seen a revival in proposals made many years ago which looked to the fitting of fixed guide blades abaft the revolving blades to recover some of the energy of the propeller race. It can be said that tunnel screws have definitely established their claims.

Passenger-Refrigerator Trades

The carriage of meat, fruit and dairy products in cold storage has become a very large trade during this generation. Perhaps the chief feature which leads to the passenger-refrigerator ship is the speed desirable for refrigerator ships —the less time on the voyage the better. Also, these cargoes are bulk rather than deadweight cargoes, which means that larger ships are needed for a given weight. Both these considerations lead to the desirability of increasing the revenues by carrying mails and passengers.

There are also some large meat carriers fitted with accommodations for passengers, a valuable revenue being derived therefrom to pay for the speed in excess of 11 knots, about a cargo carrying economical speed limit for vessels of moderate to large dimensions.

Trend of Design; Ocean Passenger Ships

As an indication of this, the following classes of ships designed in part and estimated on, since January, 1918, by one large shipyard in this country, may be of interest:

Length between perpendiculars, feet	Speed, knots	Cabin passengers	Deadweight
400	15	100	4,350
600	18	1,460	15,000
450	23	410	3,700
500	16	250	9,000
550	15¾	1,830	8,650
475	14½	445	5,530
360	13½	50	4,100
450	16	255	6,000
400	15	200	3,900

Several of these ships had third class and steerage passengers in varying numbers. These quarters were portable to a large extent, so only the first and second class quarters and permanent third class cabin accommodations have been listed above, thus giving a better guide to the characteristics of the vessel. In the 600-foot ship, accommodation for 700 third class passengers in permanent cabins is included; also in the 550-foot ship 1,160 such third class are included. The list thus gives the real cabin accommodation, whether first, second or third.

The 23-knot ship was primarily intended for a coastwise run, but also for transpacific, so that she is correctly rated as an ocean-going ship, though whether the full 23 knots would be maintained on a deep sea run is problematic.

The average length works out at 465 feet, a very modest figure for nine typical passenger ship designs, and, omitting the 23-knot ship, the speed averages 15½ knots. It would seem fair to regard the high speed of 23 knots in a 450-foot ship as quite exceptional. It is worth noting that 15½ knots is quite modest for a 465-foot ship and that it checks up with the tendency noted above. These ships are uniformly of the shelter or shade deck types with ample superstructures amidships and generally with forecastles.

*Paper read before the Society of Naval Architects and Marine Engineers, New York, November 18, 1921.

†Naval architect, New York Shipbuilding Corporation, Camden, N. J.

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Fully half these inquiries were from foreign owners, an encouraging sign.

Besides the above listed vessels, other inquiries not involving detailed design work were received; they lined up well as to type with those given and do not change the indication of the trend.

As regards proportion, the old and lingering tendency to narrow beam is at last giving way; it is not going fast, but it is yielding to two influences; the old ship that capsizes when handling light in harbor, unless ballasted, evidently is a nuisance and has plagued a good many people. The war has served to emphasize a tendency already to be seen by those on the inside, and that is to give more metacentric height and listen less to the discomfort of passenger talk that was so prevalent. Personally I feel that you have to go to metacentric heights far higher than the prevalent 18 or 24 inches in order to get appreciable discomfort; in other words, get all the data you need by studying stability and rolling features in successful ships, then adopt a G. M. about twice pre-war standards and you will have a ship that is not too stiff.

The other cause leading to more beam is the finding by Admiral Taylor and other investigators working in the experimental model basins, to the effect that more beam can often be given a ship and enough coal saved by fining up (for the same deadweight) to pay for the little extra steel weight generally involved. In other words, the bugaboo of narrow beam is under investigation and is getting to be in a bad way. It must, however, be noted that stability considerations due to the flooding of a damaged ship point to caution in increasing beam. War experience has given us a large volume of data concerning the behavior of flooded and sinking ships, and this, intimately associated with subdivision lessons, will ultimately give us safer all-around ships.

The strength of our position in cargo-carrying tonnage is not yet reflected in the passenger-carrying trade, but with our operators in the passenger trades encouraged by the delivery of new ships and by the reconditioning of captured vessels, the outlook for the future is brighter than it has been for at least two generations. There is also some encouragement for builders in that the void in their yards caused by the prevailing lack of cargo ship orders may be partly filled by orders for passenger ships. It seems safe to forecast that passenger ship construction will figure somewhat prominently in our bigger and best equipped yards during the next few years, particularly when it is remembered that a considerable number of ships now running would, but for the war, have been out of service ere this and that they will need replacement just as soon as practicable.

BULKHEAD SUBDIVISION

This subject has been very much to the front since the spring of 1912, when the world was shocked by the disaster which befell the *Titanic*. As the question stands today we have the results of the international convention to work on together with the British Bulkhead Committee's Report, followed up by such papers as those of Abell, Benvenuti, Chamberlain, Denny, Dickie, Donald, Finlay, Foster-King, Gatewood, Hovegaard, Lovett, Orlando, Robb, Wall, Webster, and Welch. We also have governmental and classification society instructions to guide us.

The war has taught us that a spacing of 40 feet is about the minimum desirable to cover war risks, as a closer spacing gives torpedoes a good chance of blowing out two bulkheads at one explosion. Our Pacific coastwise passenger steamers should have more attention in respect to bulkheads. It is proven that good bulkheading will save many a ship altogether; also that the ones it does not finally save it will often keep afloat for hours and thus give full time for rescue work to be made effective.

ONE-CLASS LINERS

As it has developed since the war, this is a relatively new idea and one which has much to commend it; on a large, high-speed liner the *de luxe* accommodation very naturally and properly occupies the best of the available space. Second class is generally aft and quite limited as to public rooms and promenades. Third class comes in below first, and the forward deck is the airing space, this being frequently so airy that none but ablebodied seamen can navigate with safety.

What better way to solve the problem than to carry the passengers willing to pay the rates on the larger and faster mail steamers and to give the benefit of the best parts of other ships to people willing to pay cabin rates for passage in slower ships, run at lesser operating costs and carrying relatively more freight. The idea works out well in connection with the moderate sized ships built since the war; it gives greater flexibility in operating fleets, taking care of seasonal changes in business conditions.

Another point which should not be lost sight of is that the one-class liner works in well with moderate first cost of ship. The one-class ship, or rather the ship with absent class distinctions, is something that deserves to succeed, and let us hope to see it do so.

LENGTH

In 1912 Mr. J. Foster-King presented some very interesting diagrams to the International Congress of Navigation in Philadelphia. These pre-war indications of the trend are extremely valuable at this time; the diagrams are produced to 1920 and thus enable performance and estimate to be compared. For the largest type of North Atlantic liner, the 1,000-footer was indicated; in the *Aquitania* and *Majestic* (ex-*Bismark*) we find pre-war justification of the forecast. Coming down to the longest types for general first class passenger service and selecting some fourteen of the most noteworthy post-war designs actually launched, we find an average length of 585 feet, the greatest being 650 feet and the smallest 505 feet—five only being 600 feet and over. Mr. King's curves gave 775 feet for Atlantic liners, excluding the leviathans, and 650 feet for general first-class liners; it is clear that the 1912 outlook has not been realized, a point also clearly brought out in several other directions; the fact that the 585-foot average includes several Atlantic liners tends further to show the reduction, the figure with which it should be compared being intermediate between 650 and 775, in a ratio difficult to get at.

It seems reasonable to say that large passenger ships have been shortened by 100 feet from considerations arising out of the war. The chief influence at work is the high cost of ships, which makes it a serious question with owners as to whether they can charge passage rates high enough to realize on their investment without killing the business of passenger carrying by reason of the inability of people in sufficient numbers to pay such rates.

THE THOUSAND-FOOT LINER

The long spell of idleness at her dock of the *Leviathan*, after invaluable troop service, is rather a damper on 1,000-foot ardor; nevertheless, it remains a fact that a vessel of this length was well in sight when the war broke out. At least one design has been seriously started and pushed to the point of a study of schedules, terminals and rail facilities,

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of a full set of outline plans, of extensive calculations and of detailed lay-out out of proposed propelling machinery.

This design contemplated going to Panama Canal lock limiting sizes at one step; it is not necessary to say that the two ships would run between New York and London, starting and arriving at deep-water harbors at each end and with rail connections to New York and London.

It can be safely said that the engineering features, especially when high tensile steel is used, present no difficulties which cannot be met. The problem is one of economics entirely. Is the route able to support such liners without government aid in some form? If not, what justification can be advanced for claiming such aid?

We can, as shipbuilders and engineers, say that, as far as our profession is concerned, we stand ready to furnish the ship and her propelling machinery just as soon as other considerations justify such a vessel. As a matter of record and interest a few particulars of the design as it stood in its earlier stages may be of interest:

Length, over all	1,000 feet
Breadth	105 feet
Depth	76 feet
Deep load draft	38 feet
Speed at sea, knots (depending on weather)	30 to 32
Shaft horsepower (maximum)	150,000
First class passengers	1,100
Second class passengers	800
Third class passengers	1,400

The propelling machinery at first contemplated was electric drive; with the large battle cruiser *Hood* at sea, the path has been opened to the full consideration of the claims of a geared turbine drive.

The oil fuel required for a round trip is in the region of 11,000 tons. This would be too much for the ship to leave this side with; the answer would be to leave here with oil for the trip over and halfway back, taking in oil for the other half of the returning voyage on the other side before leaving. At full load this vessel would have a total deadweight of about 12,000 tons. There would be no freight as is generally understood; mail, bullion and express matter, yes; also such small consignments of special freight that could be handled during the time necessary to refuel and reprovision the ship at each end.

In the early days, when this length was first proposed, the scoffers, technical and otherwise, were legion. Not so now; technical scoffers at once merely proclaim their ignorance. On the financial side there is ample room for hesitation and there the matter must rest for a while, to be taken up again as the world recovers from the effects of the war.

Depth and Draft

This subject is one calling for special mention. It can be stated at once that the drafts adopted for large liners are not those that the naval architect would choose, if he had a free hand; neither are they the ones dictated by considerations of the limitations of steel as a shipbuilding material. Terminal harbors and canals are the main deciding factors. Suffice it to say that the economics of the ship can benefit by increased draft up to the point where such increase imposes excess costs on harbor authorities, which would have to be passed back to the ship in the form of increased and excessive harbor charges.

A really first-class harbor should nowadays have a depth of at least 40 feet, and Lord Pirrie advocates 45 feet; with such depths and corresponding drafts of about 37 feet 6 inches to 42 feet 6 inches economics of transport are available. Mr. J. F. King's forecast in 1912 is worth noting; his figures gave a 1920 draft of 36 feet 6 inches for Atlantic liners and for average passenger ships. The predicted Suez Canal depth of 30 feet came very close to being a mean draft for such ships, which showed steady increase up to a 25 to 34-foot range. Draft increases relatively and actually more slowly than length, it is hardly necessary to say.

The Panama and Suez canals are bound to exercise a profound influence on the drafts of passenger liners, the figures for which now stand as follows:

1. *Panama.*—A minimum depth of 40 feet in the canal, with 40 feet in the Atlantic and 35 feet in the Pacific approaches at mean low water, which means an available draft of about 38 feet.

2. *Suez.*—At present the available depth is 32 feet and permissible draft is 30 feet; the authorities are dredging for 34 feet 6 inches and 31 feet figures respectively.

It is to be noted that Suez has gradually been deepened by dredging from 19 feet in 1870 to 32 feet in 1920.

Liners of the future will probably not be able to avail themselves of all the draft economically desirable, for we are now approaching the region of excessive dredging costs in certain harbors.

Another big factor in restricting draft is the River Plate; many vessels now trading there on a 26 feet 6 inches limit could well have been designed for 30 feet.

Speed and Power

Looking back on the not so distant days when it was necessary to plead the advantages of experimental tank work, it is gratifying to reflect on the conditions of today. In addition to resistance and estimated horsepower curves, the experimental work now being done on model propellers, both in free water and behind ship models, calls for commendation. This is a field that has been opened up comparatively recently.

In addition to deep water conditions, attention is given to shoal water problems, so important in connection with inland navigation. It is known that lines suitable for deep water are not necessarily good for shoal water.

Coming to passenger liner speeds, before the war we had reached 26 knots for all the way across the Atlantic, this in the *Lusitania* and *Mauretania*. In the later Cunarder *Aquitania* we see a reduction to 23 knots, while the large White Star boats ran in the neighborhood of 21. About the maximum for the long routes to the Cape, India and Australia was 18 knots.

Moderate speed will be a feature of new construction for a while. The average speed for fourteen post-war designs for all trades is about 16½ knots with a range of from 14 to 18 knots. New ships on the North Atlantic average up well with those on the general routes of world travel, instead of the accustomed 21 to 23 knots of the old days. In the attainment of better results, the competition in systems of propulsion does, and will to a greater extent, contribute to a lower consumption of fuel per horsepower. The problem is threefold—lower resistance, better wheels and more economical power plants.

Speed has an effect on design that is not clear at first glance. The piling up of deck houses is a noteworthy feature of many modern vessels. High deck houses are one solution of the ventilation question that cannot be ignored, for we all like an airy room.

The claims of the watertube boiler over the Scotch for high-speed ships have made good to such an extent that they will feature more largely in future ships.

The Cost of High Speed

Apart from the initial cost of the machinery necessary to obtain high speed, the fuel bills become very high. For example, consider a 750-foot Atlantic liner of varying speeds from 15 up to 30 knots; such a ship would have a beam of about 90 feet and a deep draft of 36 feet. Call the voyage 3,000 miles, which gives a round figure close enough for our purpose. Remember, too, that as speed goes up cargo carrying ability goes down and passengers, mail and express mat-

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ter become ultimately the sole sources of revenue, outside subsidy. The figures are about as follows:

Speed at Sea (Knots)	S. H. P.	Total Dead-weight	Cargo Dead-weight	Oil Fuel, One Way (Tons)	Cost of Fuel, One Way
15	16,000	29,000	26,500	1,450	$26,100
20	38,000	23,000	19,400	2,550	$45,900
25	73,000	14,000	9,000	3,900	$70,200
30	113,000	5,800	.....	5,000	$90,000

Such a vessel would carry some 600 first, 450 second and 1,000 third class passengers and would be quite big enough for speeds all the way to 30 knots. It is seen that the 30-knot ship carries nothing but passengers, mails, stores and bunkers, which is the logical outcome of this investigation. The above table will show that, with cargo capacity falling from 26,500 tons to nothing and fuel costs rising from $26,100 per voyage to $90,000, the economics of the large ship are not easy. It is clear, however, that the greater number of voyages per year for the 30-knot ship must also be taken into account. This may be summarized somewhat as follows:

Speed of Ship (Knots)	Days at Sea, One Way	Days in Port, at Each End	Days for Single Trip	Single Trips Per Year	Passengers Per Year, at 85 Percent Full	Cargo (Tons) Per Year
15	8 1/3	9	17 1/3	17.3	30,270	3,897,000
20	6 1/4	7	13 1/4	22.6	39,550	3,726,500
25	5	5	10	30	52,500	229,500
30	4 1/6	3	7 1/6	42	73,500	.....

The compensations coming to the fast boat show up in this table; she will carry more than twice the people per year at, naturally, much higher rates per person. It is also clear that the 15-knot ship does not deliver enough extra freight to compensate for the fewer and lower rate passengers carried. With everything lined up properly, the 30 knotter will make twenty-one round trips in a 300-day working year, *i. e.*, a round trip every two weeks. Two such ships, laying off during the two bad months to avoid the worst weather, could command the cream of the travel.

They are not excessive in size, and even if they only make twenty round trips per year, due to miscellaneous bad weather and sometimes taking the longer southern route to clear ice and fog, such ships equipped for first and second cabin only would each average 45,000 passengers per year, which at, say, $250 per person comes out at $11,250,000 against a fuel bill of $3,800,000, which is not so hopeless. May I commend this 750 footer as a step well worth considering in our further progress towards the solution of the problem of the modern Atlantic liner?

Another interesting angle to the speed question is that of increasing speed in vessels of moderate dimensions. A maximum speed-length ratio of unity has been a general guidance rule for ocean passenger ships for many years. With lighter machinery, oil fuel and other advances, the speed question again becomes one for renewed study and discussion.

The following table shows the fuel savings possible for high speed, moderate dimensioned vessels:

Length of ship (feet)	S. H. P. at 25 knots	S. H. P. at 30 knots
600	56,000	137,000
700	64,000	119,000
800	68,000	131,000
900	80,500	153,000
1,000	91,000	163,000

These figures represent smooth-water powers plus 10 percent for the 25 knotters and plus 15 percent for the 30 knotters. The dimensions dependent on length follow average merchant practice, except that the beam on the 1,000 footer has been limited to suit the Panama Canal lock dimensions to 102 feet.

Destroyers attain a speed-length ratio of 2.00, but it cannot be claimed that they attain it with comfort and safety except in quite moderate weather. European cross-channel steamers obtain a ratio of 1.50 with greater safety and comfort than destroyers; where the line must be drawn for the North Atlantic is our problem. The ships listed above cover a range of from 1.225 for the 600 footer to 0.95 for the 1,000 footer at 30 knots. The *Mauretania's* figure is 0.95. From this it is submitted that the 750-foot ship of 30 knots as proposed above is practicable, providing the fore ends of the ship and of the midship deck erections are especially designed and strengthened, with a view to avoiding deck damage in weather not otherwise severe enough to make slowing up necessary. All fittings and deck openings before the bridge would need to be of special design.

The question of powers to be expected, if very fast liners of warship types were to be adopted, is interesting and is another angle of the question that should be investigated. The proportions and speed both render large and high deck houses out of the question; the passage would be short and promenades would have to be arranged on the quarter deck aft and on one deck amidships well protected from spray. Fast yachts have already been built on destroyer lines, so that liners on cruiser lines are only a logical step and one that has been discussed before. The speed has been taken at a 20 percent advance on previous general practice; the time on a 3,000-mile run in moderate weather is also given. In the powers given a 10 percent margin for sea speed is allowed over a measured mile performance. The bunkers work out at quite large figures. It can be assumed that oil fuel is obligatory, coal handling would be well-nigh impossible both on board and alongside. These bunker capacities are high, but not impractical. Taking only first class passengers and allowing 1½ per foot of length, we get the numbers given in the table. The longitudinal coefficient is 0.58 and the mid area 0.90 for all lengths. It is seen that the increase from 29 to 36½ knots cuts one day off the voyage.

As regards weights, it is clear that warship practice rather than merchant would have to be followed for machinery design; the absence of armor, torpedo protection; battery and ammunition weights being utilized on deck erections, passenger accommodations and bunkers.

Mean displacement	10,000	20,000	30,000	40,000
Full displacement	11,500	22,750	33,850	45,000
Length, feet	585	735	850	930
Breadth	58.5	73.5	85	93
Mean draft	19.5	24.5	28	31
Mean speed, knots.....	29	32½	35	36½
Total E. H. P.....	27,500	61,000	97,250	135,000
Total S. H. P.....	50,000	112,500	177,500	247,500
Oil for 3,000 miles.....	2,300	4,700	6,800	9,100
Days on voyage	4.31	3.85	3.57	3.42
Passengers	875	1,100	1,275	1,400

THE BEGINNINGS OF OUR POSTWAR PASSENGER FLEET

During the war our dependence on allied troop transports led to the ordering of some twenty odd large and some thirty odd moderate sized transports at Newport News, Bethlehem, New York Shipbuilding Corporation and Hog Island. None of these vessels was completed prior to the armistice, and some were subsequently cancelled, mainly the smaller ones at Hog Island. These ships are now in service, some as troopers (Hog Island) and some as passenger liners, with the latter of which only are we here concerned. Of the larger ships, Newport News built two, Bethlehem five, and New York Shipbuilding Corporation nine, a total of sixteen ships of some 225,600 gross tons; the smaller ships number seven, all built by the New York Shipbuilding Corporation, totaling some 73,800 tons gross.

Their outline particulars are as follows:

Item	Old North State class	American Legion class
Length, overall	522′ 8″	535′ 2″
Beam, molded	62′ 0″	72′ 0″
Depth, molded	42′ 0″	50′ 0″
Load draft	32′ 3″	30′ 7″
Corresponding deadweight.	13,000	11,400

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Item	Old North State Class	American Legion Class
Sea speed, knots	14	17½
Shaft horsepower	.....	12,000
Indicated horsepower	6,500	.....
Boilers (oil fuel)	Scotch.	Watertube.
Motive power	Reciprocating engines.	Geared turbines.
First class passengers	78	260
*Third class passengers	.....	300
Gross tonnage	10,540	14,100
Crew	117	134
Bulkheads	11	13

A few words on the outstanding characteristics of these ships may be in order:

1. *Passenger accommodation.*—This is unusually spacious. Large rooms, beds rather than bunks, numerous private bathrooms, and ample public rooms are noticeable, especially in the larger vessels. Running hot and cold water is supplied in the rooms.

2. *Cargo handling.*—Both in the number of hatches and in the facilities at each hatch, this feature is especially well cared for, quick turn around being thus possible.

3. *Unusually close subdivision.*—Being laid down as three-compartment ships for troop service in the war zone, these vessels are all very well bulkheaded, especially the larger ones, where cargo is not so important.

4. The interior decoration has received greater care than usual, our colonial period supplying the dominating scheme of architectural effect. This has been modified in certain spaces, such as the verandas, tea rooms and smoking rooms. Furniture, decorations and draperies were from designs by W. & J. Sloane of New York. The architectural plans for the larger ships were mainly by the Bethlehem Shipbuilding Corporation and for the smaller ships entirely by the New York Shipbuilding Corporation.

5. Unusually large steaming radius to enable Pacific Ocean and South American trades to be adequately negotiated.

6. The similarity of bow and stern is unpleasantly noticeable, this being an inheritance from war days.

Interior Decoration

The first requisite from the point of view of the passenger, after that of the general good or bad repute in which the line and ship he sails on is held, is that the general arrangement of the accommodations shall be such as to contribute to his comfort—enough promenade space and open decks for games, ample ventilation at all times and heat in winter, well-arranged staterooms and public rooms, access to all parts under cover. An essential factor in all this is the interior decoration. As in Pullman cars, so in ships, we have happily gotten away far from the days of heavily applied ornamentation. In ships it has been realized more and more that good interior architecture and decoration do not necessarily involve additional expense, or rather expense beyond an immediately appreciable return in the enhanced reputation of the vessel in question in attracting passengers.

Of the later periods which lend themselves to ship decorative architecture the Tudor and Flemish are found most frequently in smoking rooms; the periods of Louis XIV, XV and XVI of France in the music rooms, lounges and galleries. From classic and Gothic in lesser amounts we pass on to a wealth of the Renaissance of Italy and of France, to the English and Dutch evolutions and lastly to our own Colonial, the keynote to the decoration of our postwar ships of the *American Legion* class.

We have heard lately of ships that were overdone in the lavishness of their appointments. Let ships be designed each for their own trade, with due consideration to climates passed through, to the likes and dislikes of the people carried, to the length of voyage. A rational answer to these questions will settle both the decorative and elaborateness questions.

*Two of the smaller ships are being fitted for third class in the top 'tween decks.

Extent of Arrangement of Public Rooms

The arrangement which works out best in ocean going ships gives dining rooms on the lowest passenger deck with galleys and pantries around the casings and extending full width, the other public rooms being arranged on the top deck, opening one from the other and with wide passages or galleries between, enabling the best all-round result to be obtained. A dome over the dining saloon with exhaust fans is a most important contribution to comfort, coolness, lighting and decoration.

In the larger steamers the old-time narrow passage is giving place to the gallery between public rooms. This feature enlarges the scope of the living quarters, provides library, reading and writing facilities, besides giving ample communication under cover for use during the evening or during bad weather.

Promenades

Many ships sacrifice this feature to piling in the maximum possible number of staterooms, obviously to increase revenue. The liner, to be popular, must have good open decks for lounge chairs, walking and games, with decks adapted for outdoor sleeping on tropical runs.

Outside Rooms

In smaller ships all rooms can and should be outside rooms, *i. e.*, with ports or windows opening direct to the outside air. As ships get bigger our difficulties increase; the "Bibby" room is the popular solution, the inside room having a narrow passage leading past the outside room to a port. For vessels navigating sheltered waters the transverse berth greatly helps the designer of good passenger accommodations, but for sea going ships, the fore and aft berth, with only occasional exceptions, is the rule.

Single-berth Rooms

No doubt this is a feature appealing to all people traveling alone. A most ingenious plan that can be used in all vessels, particularly in those with ample 'tween-deck height, is that of placing two berths over each other, but so stepping the dividing bulkhead that one berth is in one room and the other in another room; in one room there is a lower berth only and in the other an upper berth only.

Details of Construction

Standard transverse framing continues to be the general rule for passenger ships. Wide-spaced framing is often adopted in order to get a spacing that suits details of accommodation better. If pushed to extremes, framing too deep for good hold capacities may result, besides very heavy shell plating: in way of machinery, deep framing does not affect capacity; carefully applied, it can be made an advantage. Longitudinal framing has not the same strong hold as in oil tankers and in long shallow vessels of all classes; vessels for rivers, etc., will always do well to consider longitudinal framing, but for deep-sea passenger vessels, with many decks, its advantages are not so clear.

Cruiser sterns for twin (and above) screw ship have solid merit in improving stability and speed performances. For single screw ships they are generally a bit of a misfit.

Electric arc welding has found a definite place in shipyards and there is ample room for a welding department in any big yard to work on details.

Wooden decks inside quarters are well nigh a thing of the past in ocean ships; there are several satisfactory plastic deck coverings for all interior spaces other than those generally cemented and tiled. There are also several forms of cork flooring which give good results. Parquet may be desirable for inside dancing spaces. Wooden decks are still premier for open deck spaces over quarters and for promenades.

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In order to shorten turn around in port, either ship or dock, and sometimes both, have to be better equipped with cargo gear than was only a short time ago considered proper. The *Old North State* and *American Legion* classes fully bear this out, their twin derrick systems and numerous hatches having been commented on in every port visited. It should be noted that their close subdivision accentuates this feature.

The recent revisions of the rules of all the classification societies have placed in the hands of the shipyards methods of designing structure and details which enable much quicker and better work to be done.

Joiner work is not so dependent on wood for panels as formerly; as with sanitary floors, so with paneling, there are now on the market several satisfactory composition boards, and panels of these, mounted directly on the tongue and groove partitions, enable the two sides of a bulkhead to be fashioned to suit the furniture to much better advantage than with ordinary panels.

Lighting, heating and ventilation have improved of late; steam heat is largely replaced by electric radiators, which are particularly adapted for individual room heating in association with a thermo-tank system raising all the air to about 60 degrees, leaving the balance required to electric radiators.

With oil fuel, piping problems become more complex; the air escapes from the amidship tanks are sometimes difficult to handle in way of passenger spaces, an excessive possible head on the tanks being only avoided by taking them out through the shell. Oil fuel galley ranges are also a modern touch in oil-burning ships.

Communication and indicating devices get more complicated, fire-alarm systems, pneumercators, gyro-compass systems and submarine bell listening devices are among the newer modern tendencies.

Better bulkhead subdivision has helped fire protection; with alternates carried up to the top decks, modern ships have been afforded a much better chance of confining and subduing a fire.

The extra boatage now fitted on passenger ships has given trouble. Better bulkheads argue for less boats, though "boats for all" is rightly the generally recognized minimum acceptable. The writer feels that more rafts might well be allowed, especially where bulkheads are good.

Compulsory air ports on the lowest passenger deck might well be reconsidered.

The extent to which oil has been substituted for coal as a fuel calls for comment. Lloyd's returns indicate that 22½ percent of the world's total gross tonnage uses oil for propulsion, as compared with 3 percent in 1914, a stupendous increase and one that is mainly in vessels of American registry.

STANDARDIZATION

The British Engineering Standards Association has revised its rolled steel section standards, inviting us to cooperate. Some work has been done here along those lines and this society, with others, has appointed committees to act in conjunction with the American Engineering Standards Committee. As a result of the war we are in much better shape than formerly as regards the obtaining of a wider range of steel sections suitable for shipbuilding and are not without hope of being in better shape yet, once the revival of business brings the exporters to realize the benefits of standardization.

The British have gone further and are at work standardizing ship fittings as far as found practical and desirable; this is a far-seeing step in the maintenance of their shipbuilding position and one we should not lose sight of.

The work done in the standardization of marine oil engine construction has been fully covered recently in publications devoted to the internal-combustion engine.

Considerable progress has also been made abroad in standardizing steam marine reciprocating engine and Scotch boiler construction as far as moderate and low powers are concerned. This is advantageous in more ways than one. It facilitates construction and, equally important, it facilitates upkeep.

Anything which helps standardization along rational lines should have our united support. The claims for the prompt execution of repairs is one that should not be overlooked it is an aspect of standardization that deserves more attention than it has received, though it is largely taken care of by standardized construction.

COMPETITION AND THE FUTURE

As an indication of the need that exists for passenger ships, the following table is of interest:

WORLD'S SEA-GOING TONNAGE

	1914 Gross tons	1920 Gross tons
Liners and intermediate vessels.....	13,345,000	12,107,000
Cargo ships	24,935,000	32,518,000
Tankers	1,479,000	2,934,000
Totals	39,759,000	47,559,000

The lines of tied-up cargo ships are well explained by the above figures. The shortage in ocean passenger ships is brought out, also the wisdom of the Government in deciding to finish the main program of wartime transports later converted to passenger ships. In using the word shortage, care must be exercised to discriminate between present and normal times.

Indications are not lacking that our Pacific and South American trades are soon going to become well developed. On the North Atlantic we are not as yet adequately represented. The Pacific has given one sign of renewed progress in the *Empress of Canada*. She is almost as much a step in advance over Pacific Ocean average as the *Mauretania* was on the Atlantic. Our new liners will not long occupy any leading place among noteworthy ships, so that our hold on the trade will before long demand larger and faster vessels.

The laying down of a 30,000-ton passenger ship by Harland and Wolff for the Holland-America Line is reported, this being the largest vessel commenced in Britain since the war. The end of the retrogression in size appears to be in sight.

Shipping Board Authorizes Sale of Twenty Vessels for Conversion Into Motorships

ADMIRAL W. S. BENSON, commissioner of the United States Shipping Board in charge of construction and machinery efficiency, has announced that the Shipping Board has determined to offer for sale 20 of its vessels to purchasers who will agree under bond, or other satisfactory guarantee, to the installation of full Diesel propelling machinery in such vessels. At present day costs, this installation in a 10,000-ton vessel will amount to around one-half million dollars. Sales of Diesel tonnage have been made abroad as low as $60 but the going rate today is probably nearer $80. The Board is prepared to sell for cash the above tonnage to the highest bidder who guarantees immediate installation of types of machinery to be approved by the Board on such a basis as to make this offer an attractive one.

It is the unanimous opinion of the Shipping Board that in this action it is carrying out three important provisions of the Merchant Marine Act: first, placing of its tonnage in private hands; second, providing the most modern type of vessel for service under the American flag, and, third, giving work to American shipyards at a time when their business is at very low ebb.

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Instability

Conditions That May Lead to Instability and the Consequences That May Be Looked For

By C. H. Peabody, Dr. Eng.

IN the design of a ship much attention is given to stability, to ensure that the ship shall have enough and not too much stability in all conditions of service and even though subject to injury. It may be interesting to consider conditions that may lead to instability and what the consequences may be.

Our subject involves a negation and consequently is best approached by considering what is meant by stability and how it is secured.

Fig. 1 gives the ordinary representation of stability; a ship inclined to the angle θ has the center of buoyancy B at which

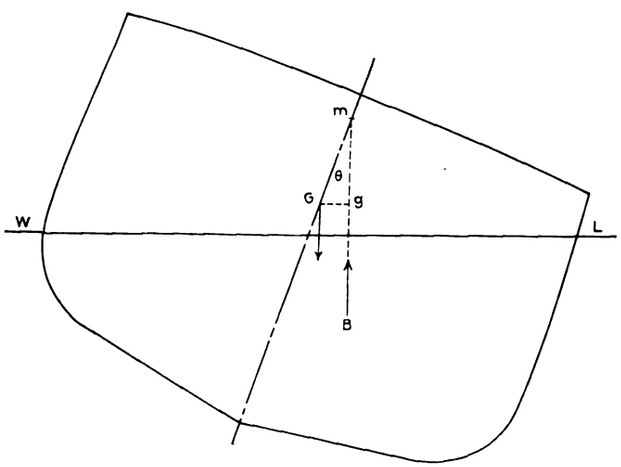

Fig. 1

the buoyant force is applied, the load or weight acting at G, the center of gravity. There is a righting couple

$$D \times G\,g \qquad (1a)$$

when D is the displacement of the ship in tons and Gg is the arm in feet. This expression is known as the stability. By

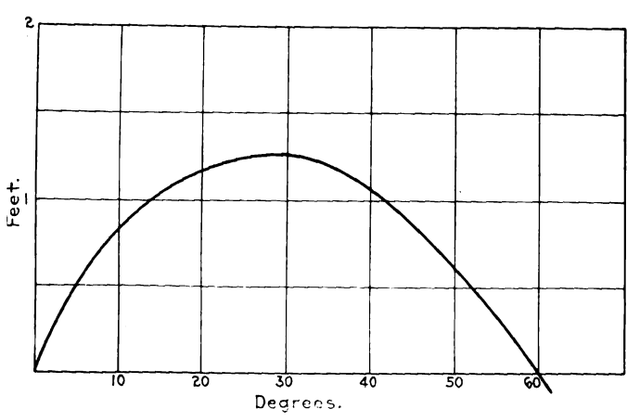

Fig. 2

methods in common use and especially with the aid of integrating instruments the arm Gg may readily be found for any angle and the diagram in Fig. 2 may be drawn which shows the righting arm for all angles up to that at which the stability disappears. The diagram is proper for a steamer which may have a maximum righting arm of 1¼ feet and a range of 60 degrees. A sailing ship will have a higher and longer diagram of stability, the range extending beyond 90 degrees.

Another, and in some ways simpler, method of dealing with stability and conditions leading to instability is by aid of the metacentric height. In Fig. 1 note that the vertical through the center of buoyancy B intersects the medial line through G at the point m; this point varies with the angle of inclination and when that angle diminishes it tends toward a definite point known as the metacenter.

Location of Metacenter

The location of the metacenter is easily determined for a special case as shown in Fig. 3. Suppose we have a floating

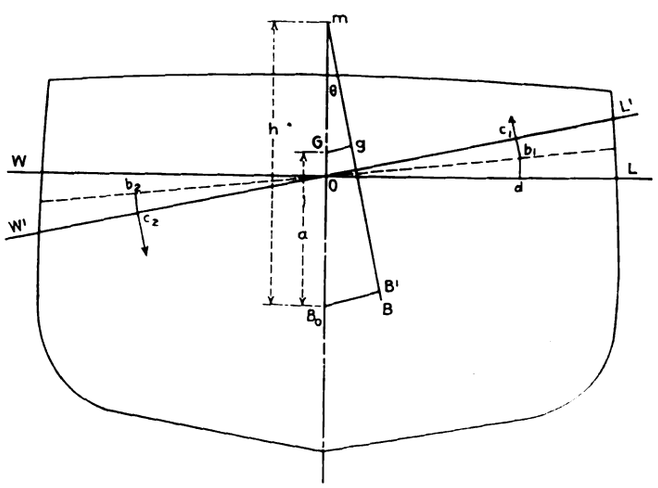

Fig. 3

body (it can hardly be called a ship) that is not only wall sided but is also square ended so that the section shown runs from end to end, or from bow to stern. The immersed volume will be found by multiplying the area below the waterline WL by the length. When the ship is inclined the new waterline $W'L'$ will pass through the midpoint O; a wedge having the area LOL' will be added and a wedge with the area WOW' will be subtracted. The center of buoyancy will go from B_o to B moving parallel to the waterline the distance BB'.

Now the shift B_oB' is produced by cutting off the wedge WOW' and moving it over to LOL', so that the center b_2 is moved to b_1, that is through the distance c_1c_2. If the volume of the immersed body is V and that of the wedge is v, then

$$V \times B_oB' = v \times c_1c_2$$

$$B_oB' = \frac{v}{V} c_1c_2 \qquad (1)$$

For the crude figure we have chosen for our floating body, or ship, all the quantities on the right hand are easily found. Thus b_1 is on the dotted line bisecting the angle LOL' and at two-thirds of the length of that line from O; but b_1c_1 is drawn perpendicular to OL' and we may draw b_1d perpendicular to OL, whereupon it is easy to see that

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$$Oc_1 = Od = \frac{2}{3} OL = \frac{1}{3} B$$

where B is the beam of the ship. Finally

$$c_1c_2 = \frac{2}{3} B.$$

As for the triangular section of the wedge added, its altitude is $\frac{1}{2} B \tan \Theta$ so that its area is

$$\frac{1}{2} \times \frac{1}{2} B \tan \theta \times \frac{1}{2} B = \frac{1}{8} B^2 \tan \theta$$

and thus the volume of the wedge is

$$V = \frac{1}{8} LB^2 \tan \theta$$

Finally substituting in equation (1) we have

$$B_0B' = 2/3\ B \times \frac{\frac{1}{8} LB^2 \tan \theta}{V}$$

$$= \frac{1/12\ LB^3 \tan \theta}{V}$$

$$= \frac{1}{V} I \tan \theta.$$

The letter I is substituted for $1/12\ LB^3$ because it is the moment of inertia of the rectangular waterline of our square ended ship having a length L and a beam B. Any figure has its own moment of inertia which can be computed or

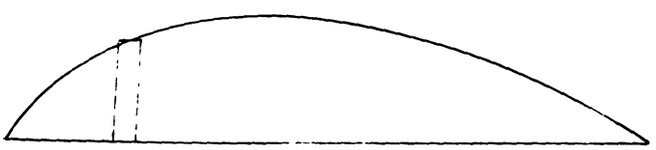

Fig. 4

measured with an integrator. Thus a figure like Fig. 4 may be divided into foot lengths for which the moment of inertia can be computed and then we may sum up for the whole figure.

Like many other things, the moment of inertia sounds worse than it is. It is rather unfortunate as a name because it is long and sounds as though it meant something mysterious. As a matter of fact it means just what it represents, that is

$$I = 1/12\ LB^3$$

for a rectangular figure and something of the same sort for any other figure. We shall later point out its importance for the understanding of stability.

Returning to Fig. 3, let us represent the distance from B_0 to m by h and the distance from G by a. First we may see that

$$B_0B' = h \sin \theta = \frac{I}{V} \tan \theta$$

so that

$$h = \frac{I}{V} \frac{1}{\cos \theta} \qquad (2)$$

It is evident that the value of h decreases with the angle θ and that as θ approaches zero h approaches the limit

$$r = \frac{I}{V} \qquad (3)$$

replacing r for h at the limit. This brings us to the consideration of the standard Fig. 5 where B is the center of buoyancy, G is the center of gravity and M is the metacenter; the last name is that given to the limit of the position of m when the ship comes to the erect position.

Returning to equation (1a) and referring at the same time to Fig. 3 we see that the expression for stability may be written

$$D \times Gg = D\ (h - a) \sin \theta$$

For small angles we may replace h by r so that the expression for stability becomes

$$D\ (r - a) \sin \theta \qquad (4)$$

The distance of the metacenter above the center of gravity

$$r - a$$

is known as the metacentric height.

Position of Center of Gravity

This equation gives satisfactory results for angles less than 15 degrees and is a fair approximation to larger angles. Let us repeat that D is the displacement of the ship in tons, r is the distance from the center of buoyancy to the metacenter, and a is the distance from the center of buoyancy to the center of gravity; while θ is the angle of inclination. Of these D and r can be computed with sufficient precision from the lines of the ship, but a which locates the center of gravity is rather difficult to determine in practice.

The location of the center of gravity of a ship depends on the vessel's purpose, construction and loading and is likely to vary widely under different conditions; this is a matter that should be thoroughly discussed by the naval architect and of which the master of the ship should have a good working knowledge. The location of the metacenter can usually be controlled by the naval architect. Consider that

$$r = \frac{I}{V} \qquad (5)$$

and

$$I = 1/12\ LB^3;$$

by small variations in B, which enters as the cube, the value of r can be given almost any desired value. Again we should have in mind that the metacentric height

$$r - a$$

is likely to vary only from $\frac{1}{2}$ to $4\frac{1}{2}$ feet while r is likely to be from 10 to 40 feet.

Instability, that is the lack of stability, may be a matter of indifference, it may be an annoyance or it may be calamitous; a few examples will be noted.

Steadiness of Ship Not Due to Stability

Contrary to a common idea, stability does not make a ship steady; on the contrary it makes a ship respond readily to

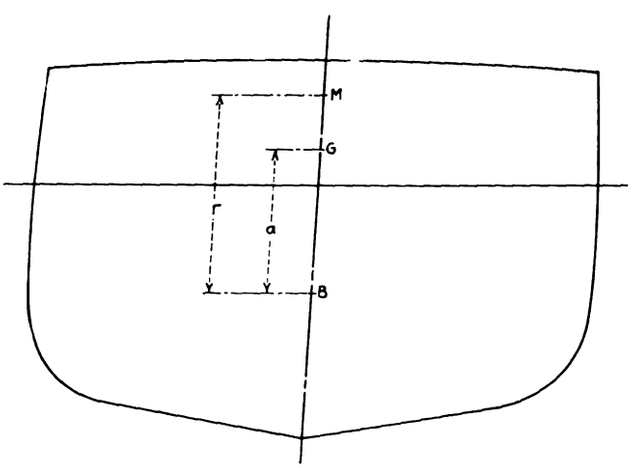

Fig. 5

the influence of the sea so that a stable or stiff ship is likely to roll badly. On high sided passenger ships steadiness is sought by giving a small metacentric height; some passenger ships for the Mediterranean Sea have been given a metacentric height of only six inches. Any ship which is designed for a small metacentric height is liable to lose its initial stability and become unstable. Such a condition will be indicated by a diagram like Fig. 6; when erect, the center of gravity is above the metacenter and the ship is unstable; it will lop over to one side to the angle where the curve crosses the axis, in this case to 10 degrees; if the ship is in a sea-

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way it is likely to roll about with a tendency to lean on one side till a wave comes along that throws it over to the other side, and then it will roll about in its new condition. So long as the ship is intact and port holes or other openings are properly closed, nothing untoward will happen. Such a condition is not assuring to the passengers and is not really desirable.

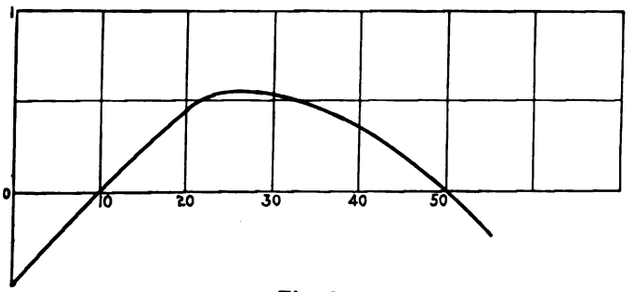

Fig. 6

Effect of Moving or Adding Weights

Before going further let us consider the effect of moving weights aboard a ship or of adding weights. Suppose the weight W_1 in Fig. 7 is raised from the hold to the deck; draw the line W_1G and divide it externally at G_o so that

$$D - W : W :: GW_1 : GG_o$$

Then from G_o draw a line to W_2; it will cut the line GM at the new center of gravity G_1; the new metacentric height will

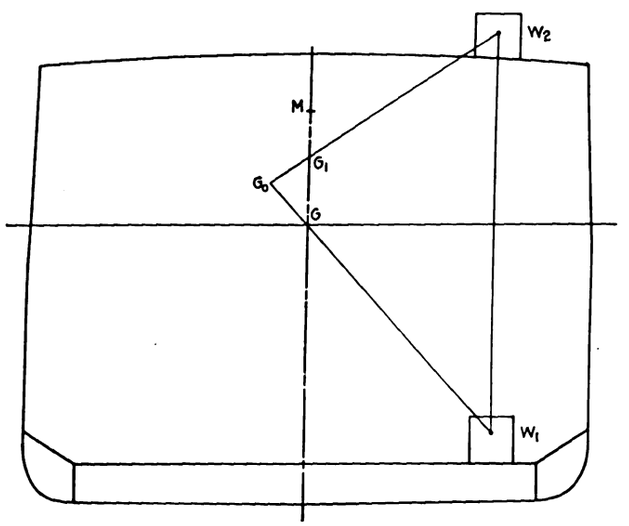

Fig. 7

be G_1M. Should the new center of gravity rise above the metacenter M, a condition of instability will arise.

It is evident at once from the figure that

$$D : W :: W_1 W_2 : GG_1$$

so that

$$GG_1 = (W_1 W_2) \frac{W}{D} \qquad (6)$$

and this equation applies for all conditions, including that with the weight W directly under G. This equation is worked out to get a clear idea of the effect of moving a weight; it may be sufficient to say that the effect is proportional to the weight and to the distance it is moved.

Addition of a weight and its effect on stability is likely to become a bit complicated for this article since it changes the displacement and the location of the metacenter. Clearly the center of buoyancy will rise further above the keel when the displacement increases and the value of r as given by equation (5) will decrease; as these two influences are contrary and as neither is very effective (except for enormous additions of weight), we may usually ignore changes of the metacenter and concentrate our attention to the weight and the location where it is added.

For merchantmen the center of gravity is commonly near the waterline; so there is a general understanding that adding weight above the waterline decreases stability and adding below the waterline increases stability. The first is likely to occur during the outfitting of a steamer or during service, because all sorts of appliances are likely to be placed on the decks; a ship may even become unstable when light from this cause. On the other hand the cargo goes into the hold and the ship may become too stiff if heavy cargo is stowed low.

Removing a weight is merely the contrary of adding a weight. Weight removed from the hold, as during unloading, raises the center of gravity of the ship. This may go on until the ship becomes unstable and then is liable to give a lurch unexpectedly. In the days when steamers carried yards, one, which was unloading at East Boston, thrust her yards down through the roof of the warehouse on the dock. A more distressing accident happened when an express steamer was unloading and coaling at the same time from a lighter alongside, all the side lights were open for ventilation. Suddenly the steamer lurched and taking water through the ports, sank at her berth; and this was in the busy passenger season.

Danger from Grounding of Vessel

When a ship grounds on the keel with a falling tide, there is great danger that she may fall over, because the reaction of the bottom has the same effect as removing a large weight at the keel, and the virtual center of gravity is likely to rise above the metacenter. That this danger is not suppositious is indicated by the fact that ships sometimes fall over in the dock, most frequently when undocking. A certain royal naval constructor was most unjustly blamed for such an accident to a royal yacht. As another example we may quote the well known danger of grounding a small boat on the beach, even in fair weather unless men are told off to go overboard and hold the boat. Many an amateur canoeist has learned this danger to his discomfort if not to the peril of others.

One of the most fertile causes of instability is the presence of loose water in a ship or boat. To make this matter clear we may direct attention first to the fact that a suspended weight is applied at the point of suspension; the moment a weight is free from the deck it is applied at the head of the boom and has its full effect on raising the center of gravity of the ship. Now water contained in a receptacle is the inverse of a floating body and has much the same properties. In Fig. 8 the water in a tank has its mobile center of figure at B and directly over is the metacenter to be located by aid of equation (5). The water in fact acts as though it were suspended from the metacenter M and must be assumed to act at that point when considering its effect on the virtual center of gravity of the ship. Of course when a closed receptable is once full of water it acts like a solid and its weight is applied where it is.

Effect of Loose Water in a Ship

A curious and frequently distressing feature of loose water is that a small amount has a high metacenter. This comes from the fact that the distance MB is

$$r = \frac{I}{V}$$

which becomes very large when V is small. We have in mind that

$$I = 1/12\ B^3 L$$

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from which it is evident that one way of curbing the rise of the virtual center of gravity is to reduce the beam *B* of the tank. This is one of the reasons for putting in midline bulkheads, which evidently makes *B* half as much and therefore greatly reduces the moment of inertia. A notable instance of the reduction of beam of free fluid is the form of expansion trunks of oil steamers; they are placed amidships and are very narrow so that the mobility of the oil has little effect.

During the loading or unloading of an oil tanker the compartments (or some of them) are partially filled and instability is likely to occur. The designer of the ship must make due provision to ensure that there shall not be any danger of capsizing; very commonly a tanker takes a list when unloading that may amount to 15 degrees, but if the designer has taken this into account the crew take that as a matter of course.

A very perplexing condition may arise if a ship, when light, loses stability due to burning of coal. If the ship has

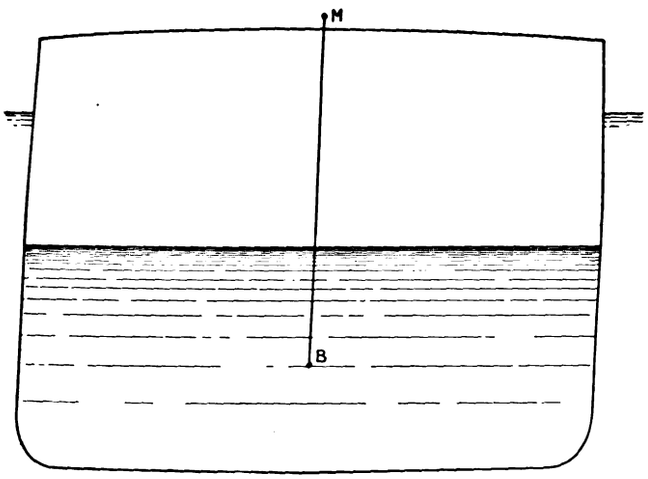

Fig. 8

water ballast tanks, the natural remedy would be to run in water; but in such case the captain must bear in mind that the first effect is to diminish the stability. But if all side openings are closed and if one compartment is dealt with at a time, there may be no occasion for alarm even though the ship should take a small list.

A very simple experiment will show some of the effects of flooding compartments. Take a common biscuit tin and set it afloat in a pan of water; the box will leak at a convenient rate. Since the metacentric height of a shallow layer of water is great, the box immediately becomes unstable and takes a list that increases more and more; but after a while the limit is reached after which the box rights and finally goes down upright.

A Mishap That Might Have Happened

Accidents that don't happen attract little attention; usually some one is blamed for being a busybody; but the old adage holds that it is better to be safe than sorry. One of the numerous pageants of recent years had as a prominent feature a magnificent barge 80 feet long and 20 feet wide all plastered over with stucco work and with a high deck to properly stage the participants. Now the designer of the barge knew it had immense initial stability and did not want interference by carping critics, so details were kept in the architects' office—not a naval but an ordinary architect. But some of the probable passengers became concerned at the policy of secrecy and the plans were submitted for official inspection.

The barge had a gasoline engine but also for proper appearance had a crew of oarsmen under the deck; the freeboard to the oar holes was of course trivial. Two cautions were impressed on the director of the pageant: (1) Keep the hold dry (this to avoid the cracker box effect) and (2) Keep the passengers from rushing over to the rail. These rules, rigorously enforced, cut out all chance of a disaster. But the architect, or somebody else, thought that more stability would help and put in a lot of sand ballast which was of course worse that futile because it lessened the freeboard and would have no effect whatever on mobility of water that might leak in. As previously stated, however, nothing happened until after the spectacle, when the barge drifted from her moorings and was wrecked on a mud flat. But computations showed that an inch of water in the hold or a rush of the passengers to the rail would submerge the oar holes after which anything could happen.

Let us contrast this commonplace affair with the capsizing of the *Eastland* in the Chicago river while taking on passengers for an excursion; a disaster that had its grewsome tale of loss of life. The published account of the investigation was inconclusive, but it is pretty certain that some water ballast tanks were partly filled and there is some question whether or not she touched bottom. A crowd of passengers at one rail was a condition evident to everyone.

The Seaworthiness of Small Boats

The writer had at one time an honorary connection with the life saving service and acquired a great interest and some trivial knowledge of small boats, not to mention his experience with canoes and skiffs. Now a good ship's boat in the hands of an able seaman is in reality a little ship competent to make long sea voyages. An acquaintance of the writer, a competent sea man, considers a voyage of 1,200 miles in such a boat as all in the day's work. That is what can be done with a well found boat. That is the kind of boats carried by ships in former years and familiar to passengers as occupying good deck room. Then came the wreck of the *Titanic* with its fearful loss of life. Legislators could easily order boats enough on every ship to accommodate all aboard; and to conform to the letter of the law the shipping companies took on board various forms of collapsible boats. Now a plain collapsible boat is evidently a poor substitute for a real boat; and yet when set up and put overboard it has saved life; it did on the doomed *Titanic*.

But the ordinary collapsible boat met the approval neither of the authorities nor of the traveling public and a variety of semi-collapsible boats was put on the market, accepted by the authorities and put aboard steamers. The lower half was built of wood or metal and provided displacement to carry the load; the upper or canvas half, when drawn up, made the craft look more like a boat and at least could keep off wind and spray. Like all compromises they were more or less unsatisfactory; when in good condition and in still water they might be useful but in service conditions any of them might be a delusion if not a snare. But they filled the letter of the law—an unreasonable law, incapable of fulfillment. The worst of them had a pontoon body and were so flat and shallow that they were more or less like a raft with the virtues and defects of a raft.

At first sight such a boat may appear more stable than a standard lifeboat; at least the empty boat had a greater metacentric height; but the passengers were carried on the deck and had a high center of gravity. Any water on the deck would have its usual tendency to instability with the further ing toward instability; the pontoon was liable to leak after exposure on the ship's deck and loose water in the pontoon would have its usual tendency to instability with the further condition that it could not be bailed out. Fortunately most of these substitutes for real boats are now discredited and retired from service.

Reference was made a moment ago to the virtues and de-

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fects of rafts. Now a raft has a large area and small draft so that its moment of inertia and metacentric height are very large; in smooth water it is very stable. It faithfully follows the surface of large swells in a seaway, but smaller waves come aboard and reduce the stability on account of reduction of the moment of inertia. A raft is liable to dip one edge, slide sideways, drop its load and then ride the waves securely.

Water in an open boat rapidly cuts down the stability. That is the real reason for bailing frantically when waves break in; should the boat be swamped, it is likely to capsize and spill all its passengers. The pressing danger is instability and an overloaded boat is in the greater danger from that cause.

The old-fashioned sailing and rowing lifeboat is passing out of service being replaced by power boats. The first power lifeboats developed in Great Britain were hydraulically propelled steamboats; the absence of external propellers enabled them to venture onto sand bars and into floating wreckage. They were like small, low tugboats, beamy and decked over. Their crews gained great confidence in them and eventually one was capsized and lost on account of over confidence; that is what happens when bold men go into danger to help others. The American boats have gasoline engines and their propellers are in cages or else in tunnels. They were developed from the old sailing and rowing boats and are handy, capable craft.

The typical lifeboat, developed in Great Britain and extensively used on our Great Lakes, was a powerful whale boat with a deck, high ends and a heavy metal keel. The deck above the waterline prevented foundering, and the combination of high closed ends and a heavy keel made the boat self-righting. These boats had a deservedly high reputation and the crews had an enthusiastic confidence in them. They were so big and heavy that they were habitually launched from fixed ways at the harbor mouth. Frequently they were towed to the windward of a wreck; after the rescue they were sailed and rowed to some haven of safety. These boats had a high reputation for stability; as a matter of fact the stability was purposely limited to secure self-righting when capsized. When capsized they were logy in still water but rolling around among waves they quickly righted. They carried gear, crew and passengers on a deck above the waterline and required skillful handling when so loaded. They were great boats and had their crews' absolute confidence.

It is related that one of these lifeboats when towed at speed by a revenue cutter to a wreck, capsized three times and each time righted without losing her crew.

Electric Propulsion of Ships *

Diesel-Electric Propulsion—Reliability—Weight—Economy—Control—Electric Drive on Warships

By W. E. Thau†

FOR practical reasons, direct current only is feasible with Diesel-electric drive. This will be evident by a proper analysis of the performance of Diesel engines in connection with the characteristics involved in applying alternating current and direct current machinery, due consideration of ship requirements being taken into account. To obtain the best results with Diesel-electric drive, it is necessary to provide several relatively small and moderately high-speed generating sets for supplying power to single or doube-unit direct connected propelling motors. Not only must the generated power divide evenly or proportionately between the generating units, but the system must also be such as will conveniently and economically lend itself to speed control to meet the requirements of service.

In the case of alternating current, it would be necessary to operate the generators in parallel. To operate alternating current generators in parallel necessitates the very closest speed regulation and practically identical angular velocities of all prime movers. To visualize properly this exacting requirement, it must be remembered that satisfactory parallel operation of alternating current generators necessitates that the angular displacement of the field poles of one machine with respect to another must not vary more than approximately ± 3 electrical degrees, or a total of 6 electrical degrees. Since 360 electrical degrees constitute the space between adjacent like poles, the total variation in mechanical degrees, for example, in the case of a 20-pole machine, must not exceed 0.6 degree. While successful operation under such requirements is carried out in several land installations where the prime movers operate at constant speed, it is not considered safe practice on board ship *where the necessity for varying the speed of all sets simultaneously* introduces another very serious difficulty. To overcome this condition successfully, would require absolutely perfect engine governors which would function 100 percent perfect at any speed setting. The speed of the motor could be varied by the rheostatic method, thus allowing the engines to operate at constant speed; however, this method is extremely wasteful at reduced speed operation, and at best offers a solution for only one of the many difficulties. It is for these reasons that alternating current is not suitable for Diesel-electric propulsion.

Direct current not only obviates all of the above difficulties, but possesses many advantages in the way of operation, control and reserve power. With direct current, we have the choice between two methods of generator operation, *i. e.*, parallel and series. From the standpoint of engine performance only, parallel operation of direct current generators is entirely feasible and easily accomplished. However, when considering economical methods of speed control of the propeller motors, another factor enters which makes parallel operation difficult, even with direct current machines. This is explained below.

With direct current, we have a choice between two methods of motor speed control, *i. e.*, armature rheostatic and generator voltage control. Armature control is not only unjustifiably wasteful at reduced speed operation, but also adds complication to the control. On the other hand, the voltage control method is practically 100 percent economical and provides an ease and a flexibility of control unapproachable by other systems. In the case of very small drives, armature rheostatic control might be selected because of factors not related to the propulsive equipment making it preferable to have a constant voltage system which is common to the propulsion and auxiliary circuits. For a drive of any appreciable size, the best results are obtained by isolating the propulsive equipment so that immediate maneuvering can be done without affecting non-related circuits. Therefore, hav-

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ing an isolated plant for propulsion only, voltage control is obviously the method to use.

With parallel operation of generators, voltage control is not simple of accomplishment. To vary satisfactorily the voltage of two or more generators simultaneously over the full range from zero to maximum, necessitates very closely and very carefully adjusted field rheostats, generators with practically identical saturation curves, and engines with practically identical regulation; or, some complicated and delicate automatic voltage balancing instrument.

The series arrangement of generators, however, is ideal from every standpoint such as operation, control, economy, simplicity, flexibility, reserve, etc. The series arrangement, in eliminating parallel operation of generators, obviates the necessity for close regulation and hence simple engine governors and simple field rheostats are entirely satisfactory. In other words, satisfactory operation is independent of variation in voltage between the different generators.

Besides the operating advantages, the series arrangement inherently provides for full power from each of the remaining generators in case of casualty to one or more of the generating sets without providing additional capacity, and consequently additional weight in the motor. To obtain full power from each of the remaining sets with parallel operation would necessitate increasing the motor field in order to lower its speed to such a value as would require the total capacity of the remaining units, thus necessitating a larger and heavier motor.

Fig. 5 shows a diagrammatic scheme of connections for a single screw Diesel-electric drive. In this particular case, there are six generating sets and one double unit direct connected motor. The six generators and the two motor units are connected in series. The machines are distributed electrically as follows: three generators, one motor unit, three generators and one motor unit, to reduce the voltage strain, or the maximum voltage to ground at any two points to one-half the total voltage of the system. The voltage of each generator being 250, we have in effect a 1500-volt system with only 750-volt insulation requirements. The advantages of this arrangement are obvious, especially in the case of large capacity drives and where there are several generators involved. The diagram shows an arrangement for using as many as may be desired of the main generating sets for supplying power to the ship's auxiliaries when in port. Although the generators (and motors) operate as pure shunt machines when driving the ship, series windings on the generators are automatically placed in circuit when the generators are connected to the auxiliary bus, and therefore, the generators operate as compound machines when supplying the auxiliary load, and when used for this purpose the generators are operated in parallel. Arranging the generators for supplying power to the ship's auxiliary bus determines the voltage of the individual machines (250 volts).

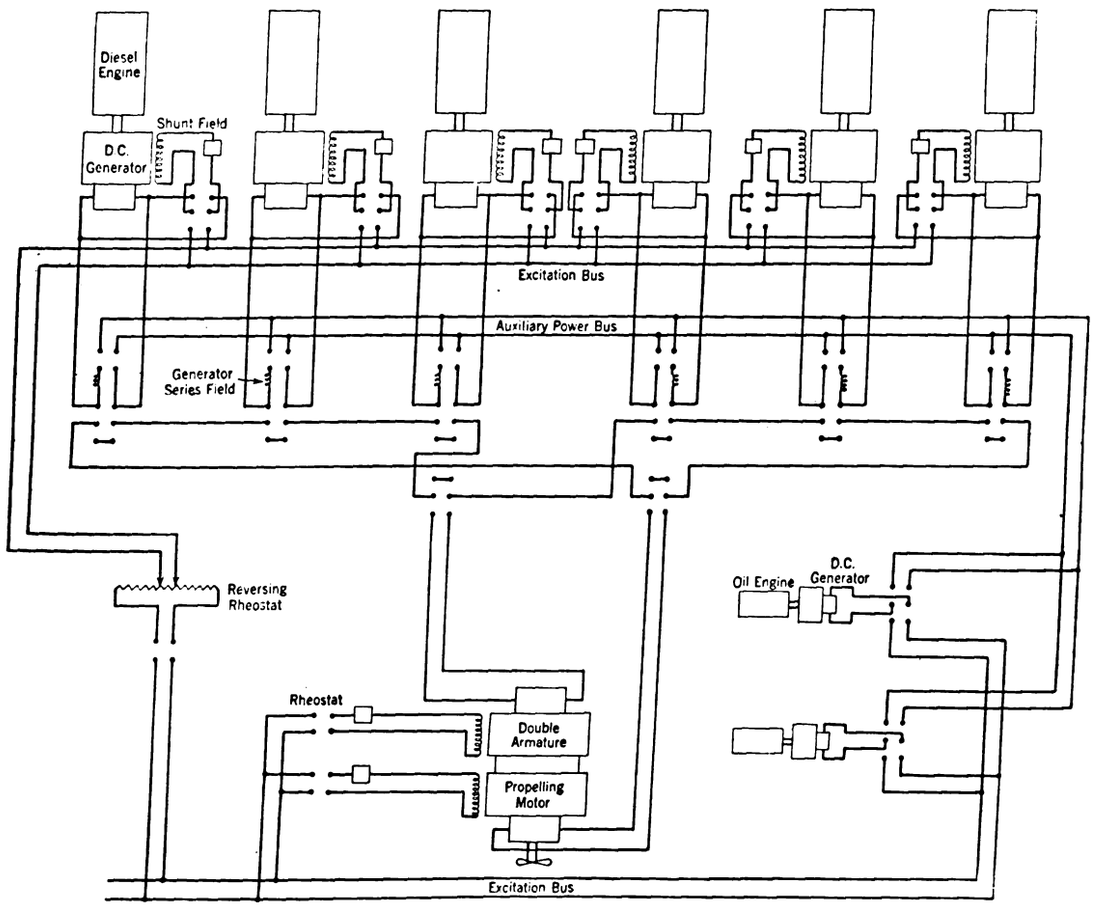

Fig. 5.—Diagrammatic Scheme of Connections for Diesel Electric Drive

The motors and generators being pure shunt-wound machines, the motor speed is adjusted to any value within the requirements by the voltage control system. In this system, the generator and motor fields are separately excited (preferably from the same excitation source). The motor fields are excited at constant potential, and in one direction, whereas the generator field excitation is varied to obtain the motor speed desired. With this arrangement, the speed of the motors is directly proportional to the generator voltage and, therefore, any motor speed from zero to the maximum in either direction is obtained by merely manipulating the generator field rheostat (a common rheostat is used for all generators). Since the rheostat handles only the generator

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field current which is 1 percent to 1½ percent of the generator rating, the simplicity and economy of the control is obvious. With the type of rheostat used, the excitation of the generators may be varied from full excitation in one direction to full excitation in the opposite direction, without opening the field circuit, and therefore, the ship can be brought from full speed ahead to full speed astern without opening a single circuit.

Reserve power in the event of casualty to prime movers is greater with this type of drive than with any other. On the basis of the power varying as the cube of the speed, a three-engine unit Diesel-electric ship can make 88 percent speed with two generators and 70 percent speed with only one generator.

The Diesel-electric has the greatest range of application of any of the economical drives (geared turbine and turbine-electric not excepted). Because of the inherent merits of this drive, it is very suitably applied to merchant ships, barges, river boats, lake boats, ferry boats, small coastwise vessels, yachts, fishing boats, coast guard cutters, cable laying ships, and any ship within its capacity requiring refined control and economical operation over a wide range of speed.

As compared with any type of steam drive, the principal advantages of the Diesel-electric are:

Fuel consumption,
Weight,
Control,
Considerably more reserve power in case of casualty to prime movers.

The principal advantages of the Diesel-electric drive as compared with direct Diesel drive are:

Reliability. Cylinder parts being thinner are not subjected to such high temperature strains in heads and liners as are the large low speed engines, and consequently, there will be fewer breakages of these parts. Years of application and service demonstrate beyond a doubt the full reliability of electrical machinery.

Maneuvering Ability and Control. The control is extremely simple, easily understood, and can be placed anywhere on the ship. The engines run at constant speed and hence the engine reversing gear is eliminated.

Weight. On a very conservative basis, the Diesel-electric should show at least 100 pounds less per propeller shaft horsepower.

Propeller Application. Propeller speed not restricted, and in the case of large ships, one propeller would be used for Diesel-electric, whereas, because of engine conditions, two would be used with direct Diesel.

Reserve Power in Case of Casualty. Very much greater with the Diesel-electric.

Maintenance. For reasons under "Reliability," the maintenance should be less. Furthermore, due to smaller parts and reserve power, repairs to Diesel-electric engines can usually be made on board ship while under way, providing sea conditions permit. The engines for Diesel-electric are designed and built on the same conservative basis as direct drive Diesels, and are not the high speed, short lived submarine type.

Less Starting Air. Diesel-electric requires starting air only during the initial start in port. Subsequent engines may be started electrically. No air is used during reversing and consequently, the air problem is reduced to simplest terms.

Fuel Consumption. There would be little difference in the net fuel oil and lubricating oil consumption as the increased efficiency of screw and the reduced strut losses, with the low speed single propeller Diesel-electric, offset the twin screw arrangement of the direct Diesel. From a standpoint of piston speed, the engines used for Diesel-electric drive are no different than direct-connected engines. (The former exceeds the latter only in *revolutions per minute.*)

Cost. The cost of Diesel-electric in some cases is less than the cost of direct connected Diesel drive on present day figures, and will generally show a greater gap when fully developed along standardized lines.

General Summary for Merchant Ship Electric Drives

In the way of a summary relative to all types of electric propulsive equipments for merchant ships, the following salient features may be reviewed:

1. Electric drive is as reliable as any drive suitable for ship propulsion.
2. Maintenance and repairs should not exceed those of other drives, and in some cases should show a saving.
3. Electric drive is ideal for ship propulsion, and will soon be recognized (if it is not already recognized), as a standard type along with the reciprocating engine, geared turbine and Diesel engine drives.
4. Electrical machines have longer life than engines or geared turbines (drives) and do not decrease in efficiency with age.
5. Electric drive (Diesel-electric) is as reliable as any economical drive generally; weighs less than any other drive; is as economical as the best; in most cases costs less than any other drive;* provides more reserve power in case of casualty to prime movers; and affords simplest and most flexible control.

War Vessels

The electric propulsive equipments for war vessels have been described and discussed in many articles in the technical press, and therefore, only the principal phases will be dealt with here.

The fact that the last nineteen capital ships of the United States Navy are, or will be equipped with electric drive, is sufficient testimony in behalf of what the builders and users of war vessels think of its merits. The prime requisite of reliability in any type of machinery designed to propel war vessels was recognized in the electrical machinery at the time of the first installation. Also the calculations showed that the unit fuel consumption over a wide range of operating speeds should be better than anything yet proposed. Service operation of two 30,000-horsepower electrically propelled battleships has indisputably proved that the reliability is all that was claimed, and that the fuel economy as compared with other ships of the same type using direct connected turbines with geared cruising turbines, is vastly superior.

Two other factors in which the electric drive shows a marked improvement over other drives, have been emphasized since the first battleship was built, namely, the superior protection from torpedo attack afforded the machinery by virtue of the arrangement of the electric plant, and the superior maneuvering qualities of the electric drive. The large horsepower requirements of the present war vessels (60,000 horsepower and 180,000 horsepower) preclude the use of reciprocating engine drive, and this leaves electric drive with a decided maneuvering advantage over any other form of turbine drive.

Of the two types of electric propulsive equipments, only the turbine-electric is suitable for propelling war vessels, because of the large capacities required. The nineteen drives installed and building employ essentially the same system in that induction motors are used in all cases. In details, the systems differ in regard to the type of induction motor. Of the three ships in service (the *Maryland* having been recently commissioned), the *New Mexico* motors have the double squirrel-cage rotor winding, the *Tennessee* motors have the form-wound rotor with external starting and maneuvering resistance, and the *Maryland* motors have combined single squirrel-cage and form-wound rotors. Each of these

*It is predicted that future developments will bring the item of cost below that of any other drive.

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ELECTRICALLY PROPELLED WAR VESSELS IN SERVICE AND BUILDING

Ship	Kind	Total S. H. P.	Type of drive	Tonnage	Date
U. S. S. *Jupiter*	Collier	7,000	Turbine-electric	20,000	1912
" *New Mexico*	Battleship	28,000	" "	33,000	1918
" *Tennessee*	"	28,000	" "	33,000	1920
" *Maryland*	"	28,000	" "	33,000	1921
" *California*	"	28,000	" "	33,000	Building
" *Colorado*	"	28,000	" "	33,000	"
" *Washington*	"	28,000	" "	33,000	"
" *West Virginia*	"	28,000	" "	33,000	"
" *South Dakota*	"	60,000	" "	43,000	"
" *Indiana*	"	60,000	" "	43,000	"
" *Montana*	"	60,000	" "	43,000	"
" *North Carolina*	"	60,000	" "	43,000	"
" *Iowa*	"	60,000	" "	43,000	"
" *Massachusetts*	"	60,000	" "	43,000	"
" *Lexington*	Battle Cruiser	180,000	" "	43,500	"
" *Constellation*	" "	180,000	" "	43,500	"
" *Saratoga*	" "	180,000	" "	43,500	"
" *Ranger*	" "	180,000	" "	43,500	"
" *Constitution*	" "	180,000	" "	43,500	"
" *United States*	" "	180,000	" "	43,500	"
Japanese Fuel Ship	Collier	8,000	" "	20,000	"
4 Coast Guard Cutters	Cutter	2,600	" "	1,600	"

ELECTRICALLY PROPELLED MERCHANT AND MISCELLANEOUS SHIPS IN SERVICE AND BUILDING

Ship	Kind	Total S. H. P.	Type of drive	Tonnage displaced	Date
2 Ice Breakers at Niagara Falls	Tug	50	Trolley or cable-fed, d-c.	.....	1906
Joseph Medill	Fireboat	400	Turbine-electric d-c.	.....	1908
Graeme Stewart	Fireboat	400	Turbine-electric d-c.	.....	1908
Electric Arc	Experimental Launch	25	Petrol electric a-c.	.....	1911
Tynemount	Cargo	500	Diesel-electric a-c.	.....	1912
Mjolner	Cargo	950	Turbine-electric a-c.	.....	1912
Wulsty Castle	Cargo	1,500	Turbine-electric a-c.	.....	1918
Aquila, etc.	Cargo	1,200	Turbine-electric a-c.	.....	1918-9
Mariner	Trawler	400	Diesel-electric d-c.	500	1919
Eclipse	Cargo	3,000	Turbine-electric a-c.	16,000	1920
Cuba	Cargo and Passenger	3,000	Turbine-electric a-c.	3,580	1920
Elfay	Schooner Yacht	90	Diesel-electric d-c.	313	1920
Guinevere	Schooner Yacht	550	Diesel-electric d-c.	1,160	1921
Invincible	Cargo	3,000	Turbine-electric a-c.	.....	Building
Archer	Cargo	3,000	Turbine-electric a-c.	.....	"
Independence	Cargo	3,000	Turbine-electric a-c.	.....	"
Alcyone	Schooner Yacht	350	Diesel-electric d-c.	.....	"
Velero II	Schooner Yacht	215	Diesel-electric d-c.	.....	"
Fordonian	Cargo	850	Diesel-electric d-c.	2,200	"
8 Cargo Carriers		3,000	Turbine-electric a-c.	16,000	"
Poughkeepsie—Highland Ferry	Ferry	200	Diesel-electric d-c.	640 DWC	"

arrangements has its advocates. However, continued service alone will decide which method is the most suitable, all factors being considered.

Because of limitations in weight and space factors, electric drive is not well suited to small, high power, fast craft such as destroyers and scout cruisers. In the case of ships where conditions are suitable for electric drive, the following discussion of the more important factors will be of interest:

Reliability

In all phases of the industrial field where electricity has entered, it has proved its reliability. With a good record for reliability behind it, electricity has set out to establish a similar record on the sea, and the experience of the two large battleships thus far equipped with electric propelling machinery, and in service, shows that there will be a duplication of past satisfactory performance. The electrical machinery will be found to be in good condition long after the ship has become obsolete.

The arrangement of units and distribution of power make it possible to supply balanced power to all screws in the event of casualty to one of the prime movers. In other words, the electric drive possesses an inherent advantage in regard to reserve power.

Economy

Regardless of calculations, the recorded performance of the electrically propelled battleship *New Mexico* has proved the superiority of the electric battleship in respect to fuel consumption. Recently published figures show that the *Idaho* and *Mississippi* use 20 percent more oil at 10 knots than the *New Mexico;* 42.7 percent more at 13 knots, 48 percent more at 16 knots, 40.1 percent more at 19 knots, and 32 percent more at full power. This superiority in fuel consumption is not altogether due to the main units, as the figures include the oil consumed by the auxiliaries. There is enough difference, however, to show conclusively that the comparison is very favorable to the electric ship.

To show that the advantage in fuel consumption demonstrated by the *New Mexico* is not a mere incident, it is well to note that the *Tennessee,* which is a later ship, is showing even better results than the *New Mexico,* as was indicated when the two ships steamed together during recent maneuvers of the Pacific Fleet. Accurate measurement of unit fuel consumption during the official trials of the *Tennessee* showed that the actual steam consumptions were less than the guaranteed figures by amounts varying from 3 percent to 8 percent approximately. Thus the art of electric propulsion is still progressing. The answer is found in the use of only a sufficient number of turbines for the load conditions, and in the two speed motors, the combination of which maintains a higher average load on the turbines at a higher average speed.

Maneuvering

Owing to the availability of full backing power in the case of the electric drive ship, the latter possesses a marked advantage over the turbine ship in maneuvering qualities. As these were referred to under "Merchant Ships," it is sufficient merely to mention at this time that electric battleships can be stopped in considerably less time than is required to stop a turbine ship. The advantage of this feature is obvious in the case of a war vessel. This is due to the combined action of quicker "set-ups" and greater backing power.

Further maneuvering advantages of the electric drive are apparent from recent publications. These advantages are chiefly concerned when entering and leaving ports and maneuvering therein. By operating the ship from one turbine set, the other, or others if there are more than two, can be held in readiness for immediate service in case of necessity such as would arise from a mudded condenser or other cause. When maneuvering to get under way, operation from a single generating set inherently enables exactly the same speed—but of opposite direction—to be obtained on the port and starboard screws. This is very desirable for the reason that the ship can be turned on its heel without making any headway. With different prime movers supplying power to

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the various screws, it would be difficult to maintain all the screws at the same speed and thereby turn in the same space.

CONTROL

The control for the propelling machinery is centralized in one compartment and can be easily arranged to be operated by one operator. The flexibility of the control is such that almost any emergency resulting from casualty to any equipment connected with the propulsive machinery proper, can be taken care of in brief time by disconnecting the disabled unit from the source of power.

MAINTENANCE

The maintenance and repairs should show to advantage because of the inherent reliability of electrical machines and the absence of wearing parts. Repairs of considerable magnitude can be made aboard the ship without removing the machinery. It is difficult to imagine a casualty to any one of the electrical units which could not be repaired on board the ship if circumstances warranted it.

STUDY OF PERFORMANCE

The electrical instruments enable accurate and convenient observations to be made of the performance of the screws at any instant. The electrical instruments also provide a means for quickly detecting improper performance of the screws due to excessive shaft friction or damaged blades. The performance of all units as indicated by the instruments is under the observation of the watch officer and control-room attendants at all times.

Memorial Tablets for Captain Ericsson

MARCH 9, 1922, will be the sixtieth anniversary of the battle of the *Monitor* and *Merrimac* at Hampton Roads, Va., which demonstrated the merits of the turreted battleship. That has been the date selected by the DeLamater Ericsson Tablet Committee of the American Society of Mechanical Engineers to memorialize the services of Mr. Cornelius H. DeLamater and Capt. John Ericsson, who for 50 years, 1839-1889, were pioneers in developing the naval, marine and industrial interests of this country, and who at the time of the Civil War, without thought of personal reward, turned their mental and financial resources to account and applied their knowledge and experience to accomplish what the Government had failed to do.

The Government has appropriated $35,000, and private individuals have subscribed a larger sum for a memorial to Captain Ericsson, in Washington adjacent to the Lincoln Memorial, and $5,000 is being raised by private subscription among engineering and marine interests to erect bronze tablets on four sites of buildings in New York City with which the lives and work of the two men were identified.

These are (1) the Phoenix Foundry, 260 West Street, between Laight and Vestry Streets, where the first iron boats in this country were built and the screw propeller was first introduced on river and ocean steamers. Some of the equipment of the *Princeton,* the first battleship with machinery and boilers below the water line safe from cannon shot, was constructed there, revolutionizing the navies of the world. The 3-inch pipe for the Croton Aqueduct and hot-air engines to pump the Croton water to the upper floors of houses were conceived and built there, as well as much other notable work. (2) The DeLamater Iron Works, foot of West 13th Street, where many industries now internationally established obtained their first development. There the first self-propelled torpedo, the first torpedo boat, the first submarine boat, and the engines for the original *Monitor,* were built, and the *Dictator* was built complete. (3) The Continental Iron Works, Greenpoint, Brooklyn, L. I., where the hull of the original *Monitor* was built and the *Puritan* and other monitors were built complete; and (4) No. 36 Beach Street, where Captain Ericsson lived and worked and died. By the *Monitor,* the navies of the world were revolutionized a second time.

The DeLamater Ericsson Tablet Committee announces that it has had a communication from the Board of Directors of the Association of Swedish Engineers (Svenska Teknologforeningen), Stockholm, Sweden, stating that they will hold a celebration of the sixtieth anniversary of the battle of the *Monitor* and *Merrimac* simultaneously with the celebration which the committee will hold in New York and Washington on March 9, 1922, as announced in the September issue of *Mechanical Engineering.* It is expected that members of the Royal Family and the American minister to Sweden will be present at the Swedish memorial meeting.

Portable Taper Boring Bar Has Wide Application in Marine Field

FOR such work as reboring propellers or other machine work where a tapered hold is required a portable taper boring bar has been developed by the Pedrick Tool & Machine Company, Philadelphia. So far as known, this is the first portable bar having the feature of adjustment for any required degree of taper.

Its operation is the same as that of the regular cylinder boring bar developed by the company in that the piece being

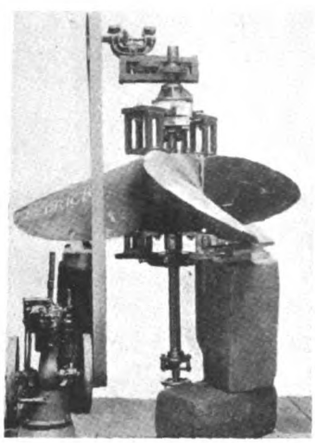

Fig. 1

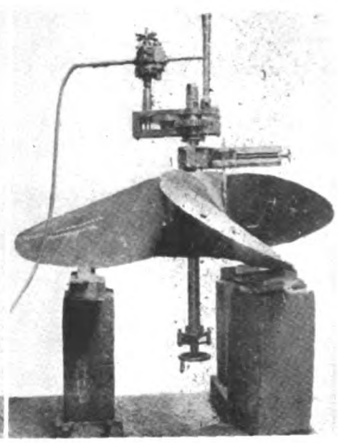

Fig. 2

bored serves as a support for the machine (Fig. 1). To this piece are fastened the crossheads that hold the boring bar. These crossheads have four set screws arranged radially for the final alinement of the bar after it has first been roughly centered in the hole to be bored. The conical motion of the bar which gives the hole the proper taper is derived from a cross slide and yoke in which the bar is secured by a gudgeon pin. The degree of taper is controlled by the distance the slide is moved from its central axis. The lower end of the bar to which the feed case is attached describes a circle. By preventing the hand wheel of the feed case from turning, either by means of a weight or some other simple method, the feed becomes constant and automatic.

The driving gear is stationary so that it may be belt driven or by an air drill or electric motor in either the vertical or horizontal positions.

In Fig. 2 the facing arm attached to the device is shown machining the hub of the propeller. This operation requires the removal of the crossheads and space blocks used in the boring operation and the attachment of a different device for holding the bar. This device consists of "spiders" which are held in the bore of the hub both on the top and bottom by projecting set screws.

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Calking Materials for Shipbuilding Purposes

By Horace Holden Thayer*

Continuation of a series of articles containing information regarding shipbuilding materials and their uses that is not readily obtainable from shipbuilding handbooks and other generally available sources. The articles are not intended to be a complete exposition of the subject but will be found to contain items of value to the various classes of workers in this field who have to deal with these materials from the materials point of view.

THE principal calking materials dealt with in this article are those required to make the seams between strakes of planking or wood decking watertight. The calking of steel is a metal to metal operation; and such packing as is occasionally required on steel ships, and the red lead putty or tallow mixtures used in stopping up otherwise inaccessible crevices on both steel and wood ships call for but brief mention.

In the calking of a wood hull or deck the seam is first nearly filled with calking cotton or oakum, or both, as the main calking materials and these are then protected by a covering of seam composition, marine glue, pitch or cement. Wood calking wedges are sometimes used for the inside ceiling of wood vessels and for floating dry docks and other special work. These different materials will now be considered.

Oakum

Oakum is a mass of strong pliable vegetable fibers which have the property of swelling when wet and are therefore called soft fibers. The fibers are impregnated with pine tar and are loosely bundled together. Before oakum is used it is worked or "spun" into "threads" which run from 40 to 75 feet in length to the pound; this spinning is done either by the manufacturer or at the shipyard. The fibers must not be too springy and on the other hand they must not be so soft as to calk into a hard wedge without elasticity.

The best fibers for marine oakum are Russian hemp; Italian hemp is next best. Sunn, sometimes called Sunn hemp, is an East Indian plant with fibers of the proper strength, absorbent qualities and resistance to decay to make good oakum but somewhat inferior to Russian and Italian hemp; Benaries is another Indian plant of the same nature.

American hemp fibers are somewhat too soft and inferior in elasticity and an oakum made entirely of them will pack solid and give poor service. Flax fibers are good but being usually more expensive than and not as good as hemp are naturally not much used.

Jute, which is the fiber from either of two other East Indian plants, does not make satisfactory oakum for shipbuilding purposes as it is more woody and weaker in tensile strength than the fibers before mentioned and is subject to rapid decay from moisture.

Oakum is often adulterated by the use of hard fibers such as Yucatan henequen, Java sisal, New Zealand flax and the ixtles, which do not swell when wet; but these can be readily detected. Not only are they not suitable in this respect but they are springy and cannot be properly wedged into the seams. Their use should therefore be absolutely prohibited.

The fibers for oakum may be new or obtained from cutting up old tarred hemp rope into short lengths and pulling the fibers apart. The oakum made from new fibers is preferable, being free from the knots or unravelled yarns which are unavoidable with oakum made from old rope.

In the spring of 1918 on account of the large amount of oakum required for the wood ships of the United States Shipping Board Emergency Fleet Corporation, the Bureau of Plant Industry of the United States Department of Agriculture and the Bureau of Standards of the Department of Commerce made an extensive study of oakum fibers. Later in the year specifications for several grades of oakum were prepared and presented to a conference at the Bureau of Standards attended by the Government bodies interested and the oakum manufacturers. The provisions of the specifications as approved by those present show clearly the relative value of the different fibers and give other information necessary for a proper selection of the material for shipbuilding purposes. They were in substance as follows:

(a) The grade known as No. 1 grade oakum shall be made from Italian, Russian or American hemp (Cannabis sativa), line or tow, or from any No. 1 grade Sunn, or No. 2 grade Benaries, or North Bengal Sunn, or from any combination of these fibers.

(b) The grade known as No. 2 grade shall conform to all the requirements of No. 1 grade except that flax fiber may be used in quantities not to exceed 25 percent of the total weight of the fibers.

(c) The grade known as No. 3 grade shall conform to all the requirements of No. 2 grade except that jute may be used in quantities not to exceed 25 percent of the total weight of the fibers.

(d) The fibers shall be thoroughly impregnated with pine tar to an amount not to exceed 30 percent of the total weight of the fiber and tar.

(e) Hemp (Cannabis sativa) recovered from old rope shall be considered the same as new hemp of the same grade and name.

(f) Where percentage of any fiber is stated it shall be understood that it is percentage of the original weight of fiber before impregnation. The original weight of the fibers shall be determined under ordinary atmospheric conditions.

(g) All oakum shall be thoroughly carded and finished, free from excessive lumps, dirt or other extraneous matter.

An explanation of the foregoing expression, "line or tow," is that the Bureau of Standards defines tow hemp as hemp obtained from the combing out process from the line hemp. Some of this tow is very short stuff that becomes waste when the oakum is spun; the more of this there is, the poorer the oakum. An oakum manufacturer on the lookout for good material can often obtain cargoes or part cargoes of hemp that have been imported for weaving and been somewhat damaged in transit at figures low enough to enable its use in oakum, with a resultant increase in the length of the fibers and the quality of the oakum produced.

The Navy Department specifications for oakum dated March 1, 1919, exactly follow provision (a), without reference to grading, and also provisions (d), (e) and (g) and retain the original Navy provisions for machine spun oakum and for delivery in bales of about 50 pounds each, compressed no more than necessary and securely bound with laths and strong tarred sisal yarns. The provision with regard to spinning is as follows:

> Oakum shall be spun by machine into slivers or threads in the form of balls or hanks not exceeding 5 pounds each; it shall be soft and uniform in texture, strong and sufficiently twisted to be suitable in all respects for calking seams of vessels. The slivers or threads shall contain not less than 43 feet to the pound and not more than 75 feet to the pound, unless otherwise required.

*Member of the firm of Rossell & Thayer, Naval Architects & Marine Engineers, Philadelphia, Pa.

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The above specifications as to spinning and packing are trade customs.

One of the best known manufacturers of marine oakum advertises his No. 1 grade of machine spun oakum as averaging about 50 feet to the pound. When a calking machine is used threads 40 feet or less to the pound for the hull, and about 55 feet for decks, have been found to be the most economical.

Machine spun oakum costs about one cent per pound more than the unspun oakum, whereas the cost of spinning it by hand will usually be several times that amount. Moreover, it contains considerably less waste than the unspun oakum. As the spinning, however, is a part of the calkers' work, they sometimes have to be taken into consideration when determining which kind to buy.

With regard to the 30 percent maximum limit of tar, before specified, the writer understands that the most used make of high grade marine oakum contains only 15 to 18 percent of tar. Thorough impregnation or absorption of the tar by the fibers is essential in order that they shall be impervious to water and this necessitates a certain amount of seasoning of the oakum.

It is very poor policy to use on any vessel anything but No. 1 grade of oakum because the cost of the initial calking is a relatively small item and of that cost the labor element is by far the greater part. Subsequent calkings are at the expense of dry dock charges, loss of service of the vessel and other undesirable features.

On account of the high percentage of labor in the calking cost and the knowledge of or ability to determine how many feet of single thread one man or pair of men will do per day, an estimate of the amount of calking material necessary for any vessel is more important from the point of view of the number of feet of thread than of its actual weight.

The following table shows the amounts of oakum and calking cotton that should fill the seams when the planks are properly laid up and the proportions of cotton and oakum that it is desirable to use. It will be noted that the total is one thread per inch of planking thickness.

Thickness of Plank, Inches	Threads of Cotton	Threads of Oakum
2	1	1
3	1	2
4	1	3
5	2	3
6	2	4
7	2	5
8	2	6

Data in possession of the writer of actual amounts of oakum and calking cotton used on wood hulls of 200 feet length and over indicate that a fairly close approximation to the weight of oakum and calking cotton required for seams that are properly laid up can be obtained in the following manner, using for L, B and D, the length from the fore side of the stem at the deck level to the aft side of the rudder post, the breadth molded and the depth molded. Thicknesses are in inches and other dimensions are in feet.

Hull to depth deck — $L \times (B+2D) \times$ average thickness planking ..... (a)

Complete calked decks — Number $\times L \times B \times$ thickness of decking ..... (b)

Complete calked bulkheads — Number $\times B \times D \times$ thickness of bulkheads ..... (c)

Erections, shaft tunnel, ceiling and other calked work — Area of surface in square feet $\times$ thickness of planking.. (d), etc.

$$\text{Weight of oakum} = \frac{(a) + (b) + (c) + (d) + \text{etc.}}{100} \times 3.5$$

Weight of cotton = about 1/5 the weight of oakum

Calking Cotton

Calking cotton is made from the short stuff or linters resulting from the carding of cotton and from sweepings and similar waste product, which is recarded and spun into threads. It is sold in small bundles and in bales of 50 and 100 pounds. When sold in bales the threads usually run about 50 feet to the pound but they can be readily subdivided to any extent desired. When in small packages the threads are usually thinner. It is graded according to length of fiber, uniformity and cleanness, and the best grade generally obtainable is none too good or too clean.

Cotton is used for calking seams in thin planking which are too small to take oakum efficiently and should be used at the bottom of all seams. It works into the point of the V with less danger of forcing it all the way through; it protects the oakum from decay due to contact with bilge water; and as it is of longer life than oakum it will form a base for any necessary subsequent recalking. In some cases where a vessel is calked entirely with cotton subsequent recalking will be done with oakum.

The preferred number of threads to use and the amounts required have just been considered under the heading of oakum.

Pitch

As before stated, pitch is used to protect the oakum, which is driven well below the face of the planks leaving space for this or some other protective covering. It must be of a nature that will not crumble or crack in cold weather or liquify or run in hot weather, which calls for a good degree of elasticity and a melting point around 150 degrees F. There are three kinds of calking pitch on the market—pine tar pitch, asphalt pitch and coal tar pitch.

Pine tar pitch, which results from boiling down pine tar, is the old and tried material that stands up in all weather conditions, is elastic and scrapes clean. The difference in cost between it and other pitch is not usually sufficient to warrant the use of any other kind on marine work.

Asphalt pitch has given good service in a number of cases and has demonstrated a considerable degree of elasticity but it is not the equal of pine tar pitch.

Coal tar pitch, which is made from the distillation of gas house and coke oven tars, is an inferior article and in tropical service will soften and work out of the seam. Some of the older wood shipbuilders consider that it acts injuriously on the oakum, paint and wood in contact with it but it is doubtful if this is true of the present day article produced by reliable manufacturers.

During the recent war the Forest Service reported a possible supply of hardwood pitch but as there was an ample supply of pine tar pitch this was not followed up.

Marine Glue

There are a number of good marine glues on the market, designed to replace pitch as the final filling of seams and protector of the oakum; they sometimes have names such as elastic seam composition, elastic calking compound, etc. Marine glue is preferable to pitch for deck seams on everything except barge, tugboat and other rough work where its slightly higher cost might not be warranted. It should be ordered from a manufacturer whose product has been proved to be successful rather than on the basis of melting point or composition.

In addition to the filling of seams, marine glue is also used in joints of joinerwork of yachts and other craft where special provisions for watertightness are desirable.

Calking Cement

This is simply pure Portland cement mixed up with water to the proper consistency, with the addition of a handful of powdered chalk or lamp black per bucket to retard the setting action. Its use is confined to the seams of the outside planking of wood vessels.

It is objectionable on a new vessel because the shrinkage of the planking and other reasons usually necessitate early

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recalking, and the removal of the cement is apt to damage the edges of the calking seams. It is of particular value on unduly wide seams of old vessels. It is also of value against teredo attack.

Where cement is used the oakum and the seam beyond the oakum should first be painted with a seam paint.

SEAM PAINTS AND COMPOSITION

These are usually proprietary products marketed by specialists in this line and by paint manufacturers. The compositions take the place of pitch, glue or cement in filling out the seams and some makes are used without any preparatory painting of the seams. With other makes a preparatory painting is advisable and the paint for this purpose is usually the composition in liquid form. On small seams paint alone will suffice.

The paints and compositions should be waterproof, durable and where used on the hull below the waterline for salt water service preferably of a nature poisonous to marine wood borers. The best guide to their selection is the results of past service. A mixture of white lead and tallow gives good service in hull planking seams.

CALKING WEDGES

As before stated, wood calking wedges are sometimes used for the inside ceiling of wood vessels and for floating dry docks and other special work. They add greatly and most beneficially to the stiffness of the structure.

The wood used should have the property of swelling considerably when wet, and white pine is ideal for this purpose. White pine calking wedges are a staple article of commerce. The heartwood of thoroughly seasoned bald cypress, red cedar or Douglas fir may be used, subject to classification or other necessary approval.

A convenient size of wedge is 4 inches deep, with a thickness of 7/16 inch at the butt and tapering to a point, and with a width of 3⅝ inches at one end and 3¼ inches at the other. Alternate wedges having the larger width at the point are first driven and then the intermediate wedges having the larger width at the butt are driven between them. The seams have to be properly outgaged and carefully reamed and cleaned out.

LEAD AND TALLOW MIXTURES

These mixtures, while often used to cover up poor workmanship, are sometimes unavoidable for stopping up leaks in otherwise inaccessible places in both steel and wood construction. They are forced into the crevices with compressed air or mechanical pressure from a so-called gun, through a hole drilled or bored in a location that will communicate with the spaces requiring to be filled up.

For watertight work on steel ships a good mixture is a putty made by mixing red lead powder into white lead paste, with a little whiting added where necessary to harden it. For oil tight work on steel ships a good mixture is a putty made by adding sifted powdered Portland cement to equal parts of liquid pine tar and shellac.

For wood ships a mixture of red lead and tallow is used. In and around deadwoods the mixture is made thin but where the trouble is localized a thick pasty mixture is used. The tallow stops the leak and the red lead prevents its caking too quickly and also poisons it so that the rats will not eat it. White lead and tallow to cover the calking in planking seams have been previously referred to.

PACKING

Packing is sometimes used as an aid to watertightness in steel to steel calking. Like the mixtures just dealt with it is in the nature of a necessary evil, with a tendency to make use of it where it should not be required. In some cases the use of packing is commendable, such as under doubling plates, along plate landings in repair work where the surface has become roughened by corrosion, and between castings and steel plating.

The packing is ship sheathing felt or thin canvas thoroughly soaked in red lead or some bituminous compound that has been proved to give good results when so used.

President Plans Definite Shipping Policy

Expert Committee Preparing Concrete Plan of Government Aid to Shipping, to Be Submitted Early in January

AFTER several months of consideration the administration has decided that it is impossible to build up an American merchant marine and dispose of the ships now owned by the Government to private companies without some kind of a ship subsidy. President Harding has indicated his intention of going before Congress early in January with a special message in which he will advocate a concrete plan of Government aid to shipping in complete detail and the legislation on this subject is expected to form an important part of the program for the regular Congressional session which opened on December 5.

The exact form of the plan is yet to be determined but is being worked out by the Shipping Board with the assistance of a committee of outside experts working under the direction of Commissioner Meyer Lissner. The White House had previously let it be known that the President had been advised by the State Department that it would be unwise and imprudent to enforce Section 34 of the Jones law, and that the President would recommend a substitute to Congress. The subsidy plan is to be the substitute which will assist the development of American shipping by other means than by a policy of discrimination. In this connection so many objections have also appeared to the enforcement of Section 28 of the merchant marine law, intended to restrict preferential rail export and import rates to freight shipped in American bottoms, that there have been many predictions that it will not be applied.

FORM OF SUBSIDY

The study being made under the direction of Commissioner Lissner, which is now taking form, involves not only the question of the amount of assistance required but also of the form of the subsidy, whether a direct subsidy such as the proposal of the shipowners some time ago for a payment of $5 per gross ton per year, or aids, such as for example a provision that 50 percent of the immigrants allowed to enter the United States shall be required to travel on American ships. The recommendations to be made to the President will cover what is necessary in each route or type of service, including what is necessary to take care of the wage differential.

It is believed that some form of subsidy will hasten the time when it will be possible for the Shipping Board to get out of the business of ship operation as it will increase the chances for selling the Government-owned boats. The reasons advanced as to why a ship subsidy is necessary are

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first, to enable the American merchant marine to compete with long-established foreign competitors who have been aided by their own governments, and to overcome the higher cost of construction in this country as well as the higher wages paid to American crews.

The proposed 10-year naval holiday is also advanced as a reason for giving some encouragement to shipbuilding on the ground that, if naval construction is practically shut off for that period of time, shipbuilding in this country will become a lost art.

One of the plans under consideration is, in place of imposing discriminating duties on traffic brought to this country in foreign vessels, to devote a percentage of all the duties actually collected to the aid of American ships.

PRESIDENT'S SPECIAL COMMITTEE

Those who are making the study of ship subsidies for the Board are: Professor Emory R. Johnson, of the University of Pennsylvania; W. L. Marvin, vice-president of the American Steamship Owners' Association; Rear-Admiral H. H. Rousseau; Admiral C. S. Williams, Daniel H. Cox, naval architect, Grosvener N. Jones, authority on ship subsidies; Norman Beecher, admiralty counsel of the Shipping Board. Those studying the insurance phase of the situation are: Professor William Leslie, of the University of California; Dr. S. S. Huebner, professor of insurance at the University of Pennsylvania; W. C. Rader, in charge of marine insurance for the Standard Oil Company of New Jersey; B. K. Ogden, in charge of marine insurance for the Shipping Board, and Vice-President W. J. Love of the Emergency Fleet Corporation.

In his address to Congress at the opening of the session on December 6 President Harding discussed merchant marine affairs as follows:

THE JONES ACT

"The previous Congress, deeply concerned in behalf of our merchant marine, in 1920 enacted the existing shipping law, designed for the upbuilding of the American merchant marine. Among other things provided to encourage our shipping on the world's seas, the executive was directed to give notice of the termination of all existing commercial treaties in order to admit of reduced duties on imports carried in American bottoms.

"During the life of the act no executive has complied with this order of the Congress. When the present administration came into responsibility, it began an early inquiry into the failure to execute the expressed purpose of the Jones act. Only one conclusion has been possible.

"Frankly, members of House and Senate, eager as I am to join you in the making of an American merchant marine commensurate with our commerce, the denouncement of our commercial treaties would involve us in a chaos of trade relationships and add indescribably to the confusion of the already disordered commercial world.

"Our power to do so is not disputed, but power and ships, without comity of relationship, will not give us the expanded trade which is inseparably linked with a great merchant marine. Moreover, the applied reduction of duty, for which the treaty denouncements were necessary, encouraged only the carrying of dutiable imports to our shores, while the tonnage which unfurls the flag on the seas is both free and dutiable, and the cargoes which make a nation eminent in trade are outgoing, rather than incoming.

PLAN FOR SHIP SUBSIDY

"It is not my thought to lay the problem in detail before you today. It is desired only to say to you that the executive branch of the government, uninfluenced by the protest of any nation, for none has been made, is well convinced that your proposal, highly intended and heartily supported here, is so fraught with difficulties and so marked by tendencies to discourage trade expansion that I invite your tolerance of noncompliance for a very few weeks until a plan may be presented which contemplates no greater draft upon the public treasury, and which, though yet too crude to offer you today, gives such promise of expanding our merchant marine that it will argue its own approval.

"It is enough to say today that we are so possessed of ships and the American intention to establish a merchant marine is so unalterable that a plan of reimbursement, at no other cost than is contemplated in the existing act, will appeal to the pride and encourage the hope of all the American people."

The Most Interesting Job in the Yard

Here is another contender in the controversy over which is the most interesting job in the yard. In the October and November 1921 issues were published the claims of a machinist in the engineering department of a ship repair yard and of an engineer in the office of a large shipyard. Now comes a veteran who not only has designed engines but has erected them in the shop and operated them on board ship. How does YOUR job compare with these? Tell us about it and why you think it is the most interesting job in the yard. Who's next?

THE letter by "Nulli Secundus," page 761, of the October issue, interests me. If a workman of any kind, in any branch of the mechanic arts, is really in love with his work naturally he will think that *his* work in particular is "the most interesting job in the yard." This is what might be called "departmental pride," which is justifiable as long as it does not disbar co-operative effort in production as a whole. So, the correspondent who signs himself as "second to none" thinks the machine work part of the yard as a whole is "the most interesting job." Well, it is interesting but, to me, not the *most* interesting by a good deal.

I have been engaged in various operations in marine engine works and shipyards, from the drafting board to installing the machinery "on board," and then operating that machinery as an engineer's officer of the watch, for several years. (Incidentally I held a chief's unlimited tonnage certificate.) Therefore, I would like to add my "say so" in regard to the matter.

I think the most interesting job in the yard is the erection of the engines in the shop, and next to that, the installation of the engines in the ship. The erecting engineer *must* know something more, both in detail and as a whole, than is required of any of the "tool hands" (or "machine hands," which is perhaps the better expression). The bringing together, the assembling of the various parts of the engine requires more than merely bolting them together. Measurements must be checked up from blueprints and dimensions compared for accuracy of the work as turned out by the various machines involved. Mistakes may be made, and pass unnoticed, while the process of machining is going on, but those mistakes must be discovered in the process of erection, else serious consequences may follow.

In my contention that "the most interesting job in the yard" is the assembling and erecting of the various parts which make up the whole, let us consider the erection of a three cylinder, triple expansion reciprocating marine steam engine. I shall touch only the "high spots" at this time as time and space do not permit of going into a full and detailed description and explanation.

We will assume a suitable shop in all aspects in which such an engine may be built from start to finish. The various parts have been designed, patterns and castings made,

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forgings turned out from the smith's shop, and all these have been "laid out" from blueprints or other drawings, so that the various machine hands can finish the parts to the required dimensions. This involves all kinds of machine work, such as planing, boring, drilling, turning, slotting, milling, shaping, etc.

The bedplate, having been planed (i. e., the upper surface, upon which the feet of the six columns rest, the openings for the six main shaft bearings to be housed, and also the upper surface of all the housings), is now ready to be "set up," either on the floor or in a pit for that particular purpose as conditions may require. In some work the overhead traveling crane which must handle all the heavy parts is not sufficiently high to permit of a very large engine being set up on the floor level, hence the necessity for a "pit."

The bedplate is set level by wedges under it, the spirit level being applied to the planed surfaces on top. During the erection of the entire engine the bedplate is tested for possible settling down out of level, and, if so found, a readjustment of the wedges corrects the trouble.

Next, the columns are set up, the tops of the six columns and also the feet are supposed to be correctly planed, so that they are exactly the same length and, also, so that when secured by the bolts at the base to the bedplate the tops of the columns are in the same plane and level as the bedplate is. As well as this, the planed faces of the crosshead guides must be parallel, or nearly so, as measured by a gage applied at the top and bottom ends of each pair of columns.

Sometimes it happens that the three planed surfaces of each column are not exactly true with one another, as discovered when setting them all up on the bedplate and gaging distances, etc. In that case, the foot of the column, or columns, must be faced to bring the surfaces true.

After all the columns have been "trued" up and securely bolted to the bedplate through two or more of the holes in the base of each column and in the bedplate, they are reamed and properly fitted bolts are driven in and secured by nuts. Thus the columns are prevented from twisting or getting "out of line" or "out of true" in any direction. Proper precautions are also taken to prevent the tops of the columns springing inwards, towards each other, until the cylinders are ready to be placed thereon. The correct location of each pair of columns, i. e., those for the high pressure cylinder, those for the intermediate cylinder and those for the low pressure cylinder, has been determined by the use of plumb bob centerlines between each pair of columns, gaging between the falls of the guides and by testing with a centerline running fore and aft through the bearings in the bedplate.

Thus by these means let us say that the six columns are correctly set on, and properly secured to, the bedplate, all in correct relationship to one another and according to the dimensions and distances as specified in the drawings. After this the whole structure is tested again for being level.

Next in order is the testing of the tops of the six columns for being in the same plane, level in a fore and aft direction, as well as in the athwartship direction. The test is made by the use of long metal straight edges and also by the use of a spirit level of good design. The top surfaces of the columns must be made right, for, if they are not, the cylinders will not be truly in line. Shims might be used to make up for inequalities of the column tops, but it is better to reface the tops of those columns that are "out" and thus make a correct job of it.

In the meantime, the cylinders have been bored and the various surfaces planed, including the feet, which are to be secured to the tops of the columns. Assume the cylinders to be finished—as far as is necessary for placing them on top of the columns—which means that they are all true with one another, both with regard to the bores and also the planed surfaces, and that the feet are all in one plane, so that when the entire "block" is placed upon the column tops the faces meet and require no "shimming" or "springing" to bring them together.

Then centerlines are run through each cylinder, so as to intersect the horizontal centerline through the bearing housings, and the cylinders are correctly set according to the requirements of the drawings. After the cylinders have been correctly located so as to be in line fore and aft and athwartships, the feet are securely bolted to the tops of the columns. Here, also, two holes (or more if desired) are reamed and fitted with driven-in bolts. All the bolts fitted in the reamed holes should be marked for their respective places, so that after dismantling the engine and setting it up in the ship, the bolts will be correctly placed and all the parts come exactly right again.

So far we have the principal heavy parts of the engine erected and in true relationship and alinement. It is now a matter of correctly assembling the minor parts and by centerlines, gages, levels, etc., set them also in their correct positions, using the drawings as guides for dimensions and location of various parts.

I think enough has been written to support my claim, that the erection of an engine is the most interesting job in the yard.

The erector deals with, and is concerned with, the *whole* machine, while the various machine hands are concerned only with their individual parts to be made. They cannot feel the same interest in the machine being constructed and "set up" as the man, or men, who are employed on the actual erection work. Even the workmen themselves look upon an erector as a somewhat superior man. Why? Because he is engaged in a superior work—a most interesting job. And then, who are the men usually selected "to go down to the sea in ships" as engineers? The men who produce the individual parts of the engines? No, seldom, if ever. The men chosen are those who erected the engine, assembled the parts and made it possible for the machine as a whole "to run" and serve the full purpose for which it was made.

Brooklyn, N. Y. CHARLES J. MASON.

Shipments Via Panama Canal

"IT is evident that the Pacific coast is taking advantage of the cheap transportation which the Canal affords for bulky commodities to eastern United States and Europe," said E. S. Gregg, chief of the transportation division of the Department of Commerce, in a statement on the Panama Canal in which he submitted detailed statistics showing increased tonnage moving via the Canal.

"Steamers in the intercoastal trade are endeavoring to equal the time made by the transcontinental railroads. Oranges and lemons have been shipped from California to New York by water in 19 days. While the railroads occasionally move fruit across the continent in two weeks, the average time is probably not under 20 days. A saving of about 25 percent in rates is effected by the all-water route. It is claimed that the percentage of decay in fruit arriving at Atlantic ports by water is less than when shipped by the rail routes.

"Intercoastal trade through the Canal shows a pronounced increase during this year as compared with 1920.

"During the war and as long as rates were high on foreign traffic, ships were induced to forsake coastwise trade. Since the slump in rates, however, many American ships have returned to the protected intercoastal trade, and an increasing amount of cargo is being carried between the Atlantic and Pacific ports of the United States by water.

"Europe is taking large quantities of Pacific Coast wheat this year; during the first eight months of 1921, 506,058 tons were shipped to Europe, as compared with a total shipment of 749,447 tons of all kinds of cargo during the 12 months of 1920."

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Compounding the Internal Combustion Engine*

By Elmer A. Sperry

The compound combustion engine is light compared with the normal Diesel, being in special cases less than one-tenth, and in some instances less than one-twentieth, the weight for the same output. Its mechanical efficiency is extremely high, and a distinct gain in overall efficiency from fuel to shaft has been made, as well as a very definite gain in simplicity, direct performance and smoothness of the crankshaft diagram. This has been achieved while adhering to the four-cycle operation. This paper presents the results of research by the author extending over a series of years, during which not only has the high-pressure principle been thoroughly established, but all the important requirements have been worked out, and finally an engine embodying practically all the advantages has been subjected to long continuous runs.

IN America, a group headed by the author has been engaged on the problem of compounding the internal combustion engine for upward of thirty years. A number of engines have steadily followed each other, each involving improvements resulting from previous experience, until the essential problems have been conquered. Not only has the principle been thoroughly established, but all the important refinements have been worked out, and finally an engine embodying practically all the advances has been subjected to long continuous runs. Data almost invaluable to the art have been secured, together with a series of indicator cards and diagrams that exceed a thousand in number.

The outcome has been that the various prophecies of thoughtful engineers in the past have been more than fulfilled and there is every evidence that the heavy-duty compound combustion engine is everything that was hoped for. It is light compared with the normal Diesel, being in special cases less than one-tenth, and in some instances less than one-twentieth, in weight for the same output. Its mechanical efficiency is extremely high, a distinct gain in overall efficiency from fuel to shaft has been made, as well as a very definite gain in simplicity, direct performance and smoothness of the crankshaft diagram. This has been achieved while adhering to the best practice, namely, four-cycle operation.

Compounds Lighter and Cheaper

The lightness and simplicity of the compound solves the capital-charge factor automatically. Engines of this type weighing only a fraction of the weight of the present Diesel will inevitably be found to be much less in first cost as well as in cost of upkeep.

Our own Government has come forward with orders for an initial engine which, together with orders from other sources, is now under construction. To illustrate to what low figures the compound principle can be relied upon to bring the heavy-oil engine, it should be stated that among these orders is one now under construction to weigh about five pounds to the brake horsepower. This may be looked upon as extreme, but the designed weights and finished parts as they now stand are below this figure. The old single-stage compression is discarded in the compound and the modern method of two-stage compression is adopted.

Chilled Surfaces Reduced

Supercharging or compressing in two stages gives the controlling advantage in that a very much larger unit volume of gases may be handled. The clearance spaces may be many times the size of those in the Diesel, and yet it is perfectly simple to bring these large volumes up to the requisite pressure and incandescent temperatures at the instant of fuel injection.

While retaining all of the chilled walls that are necessary for proper handling of the lubrication, still a gain is made on the order of 60 percent in the extent of these chilled walls in the compound as compared with the simple engine.

Solid Fuel Injection

With the large clearance volume we no longer have difficulty with solid injection, nor do we have any difficulty in using a wide range of heavy fuels. In the compound engine the clearance volume is so large that the entire high pressure piston displacement causes it to lose only a fraction of its pressure, thus bringing to the second stage, or low pressure, both ample volume and pressure so that this piston (representing 6, 8 or even 10 times the area of the high pressure) is driven to the end of its stroke with pressures still above the atmosphere.

Much Greater Expansion, Higher Efficiencies

In this way the engine yields an expansion ratio based on gage pressures, which instead of being 3 or 4 to 1, as in the case of the automobile engine, or about 12 to 1 in the Diesel, can be made as high as 120 to 1. A higher return and greater efficiency from the fuel are secured because of the lower temperature of the exhaust.

Utilizing the Detonation of Fuels

Through a research extending over a year and a half or more, conditions were discovered by means of which "detonation" of the fuels may invariably be secured. The author found that the *thermodynamic efficiency was higher in case of high detonation diagrams* than with low. Our work has been toward realizing these high efficiencies by developing instead of suppressing this high-intensity combustion. One of the achievements of high-intensity combustion is better thermal efficiency and a still further reduction in the exhaust temperatures.

Elimination of Losses in Transfer

In early attempts at compounding it was found that prohibitive losses would occur in the transfer, due to the falling pressures while filling the low pressure clearances. A complete solution of this is found in a special adaptation of the process of "cushioning"—closing the exhaust valve at a predetermined point before the out-stroke end, trapping a little of the hot gases and cushioning them up to the transfer pressure so the transfer valve opens under conditions of equal pressure on each side. There is, therefore, no flow of gases except that due to the slow starting of the strokes of the two pistons. There are practically no losses sustained in cushioning; the power of compression is returned very completely on expansion. In this unique adaptation of cushioning the additional advantage is secured of preventing all erosion due to high velocities of the hot gases over the transfer seats. These seats are amply jacketed and are found to remain smooth, bright and perfectly sealed over long periods. It is incidentally found that in cushioning, the

*Extracts from a paper read before the American Society of Mechanical Engineers, New York, December, 1921.

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adiabatic compression of the hot gases brings with it an equality of *temperatures* as well as pressures, so there is neither loss in pressure nor temperature at this critical point of transfer and the efficiencies are carried at high values throughout the cycle. In the compound engine the exponents hold very closely to the adiabatic throughout the cycle due to less cooling, owing to the very low ratio of chilled wall surfaces to unit volume of power gases and the large unit volumes employed.

An important feature of compounding is the complete suppression of all preignition. All the early part of the compression occurs entirely extraneous to the combustion chamber, where air only is handled, and only the latter part or second stage of the compression occurs in the combustion cylinder, so the engine is simplified because no troublesome and often leaky safety valves or pressure relief valves are required or fitted.

THE TRANSFER-VALVE PROBLEM

The transfer valve considered as an exhaust valve is called upon to handle much hotter gases than ever heretofore. A difficult situation is here presented. Are special materials necessary and how can the valve successfully perform this duty? It is known that the exhaust valves of the Liberty motor run red hot and the stems white hot, and yet they are handling gases of lower temperature than are here present.

Compression in the compound is by the modern two-stage method. Air is admitted to the combustion chamber under comparatively high pressure and although it is warm, yet with each atmosphere of pressure its cooling powers are doubled. Air at 100 pounds thus has seven times the cooling power of atmospheric air, seven times the weight and seven times the molecules in contact for cooling. In forcing the high-pressure piston down, air must pass some port in entering. Now, as a matter of fact, this port is in line with the transfer port and the induction valve itself rides on the back of the transfer valve in the form of a hollow sleeve *I* (Fig. 2) seated directly on the top of the transfer valve *T*. The back of the transfer valve is provided with greatly enlarged radiating and cooling surfaces presented to this cooling air and powerful convection currents are constantly acting when sealed. Moreover, this air when entering is at high velocity and gushes down through and bathes the deeply serrated surfaces of the back of the transfer valve, licking up the heat very completely in its inward rush.

INTENSIVE COOLING EFFECTIVE

Now in following out the cycle, it will be noticed that this is the very step that follows directly on the heels of the transfer of the hot gases and continues throughout the next quarter cycle and through the entire descent of the high-pressure piston, which in this way delivers a real power stroke to the crank with mean effectives in some instances greater than the mean effective pressures of the ordinary Diesel, thus returning some of the power taken to drive the supercharger or first stage pump. If the transfer valve is intensely heated on its under surface (see *T*, Fig. 2) and is then instantly intensely cooled on a surface five times as great, it will certainly strike and maintain a heat balance which in practice is found to be extremely low, only about one-half the temperature of the Liberty valves, nowhere nearly approaching red heat nor the temperature of normal Diesel exhaust valves under load conditions. Here is the crux of successful compounding, the great obstacle which has always been looked upon as practically insurmountable, solved by an extremely simple and straightforward method. In fact, the temperatures of the valve are lower than the calculated temperature balance because of the high velocity of the induction gases from the receiver.

Again, the heat in these gases absorbed from the hot valve is useful inasmuch as it is the auto-ignition temperatures as well as pressures that are required at the end of the compression curve. Here a useful heat transfer and pure regenerative process is carried out. The seats give no trouble because they are backed by the ample water jackets and, in fact, the whole transfer valve gear operates continuously and successfully and is found to be in perfect condition after hundreds and even thousands of hours of operation. They require practically no attention and are seldom ground in. This is exactly as it should be, considering the very low temperatures at which this valve really operates.

HOW LIGHTNESS IS OBTAINED

The question often asked is, to just what is due the smallness and lightness of the compound engine? It is this: In the four-cycle Diesel we have the tonnage of metal due to the presence of high pressures, operating at a ridiculously low material efficiency because these high pressures persist only about 2½ percent of the total time. The Diesel card rises abruptly and immediately falls. All the rest of the time, over 95 percent, either low pressures or no pressures at all are present, whereas in the compound the pressures *persist* and we are dealing with great blocks of power. Although the pressures are not materially higher than in Diesel

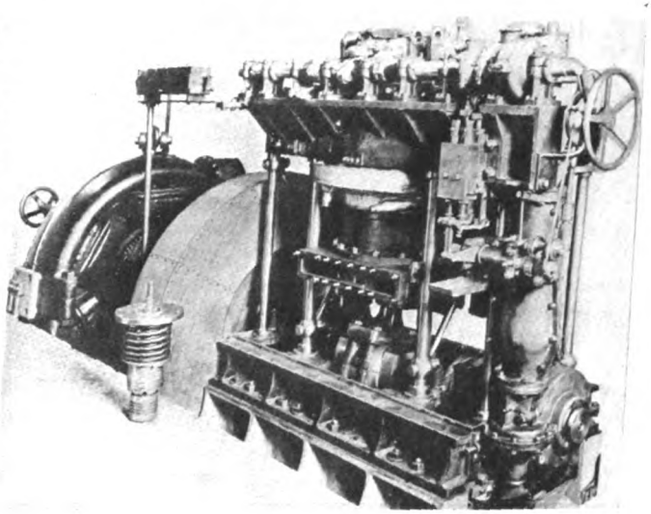

Fig. 1.—Marine Compound Oil Engine Built for Heavy Duty

practice, they are made to persist practically clear across the card, producing very large gross mean effectives. This is instantly followed by another line clear across the card, again producing another large gross mean effective in the low-pressure cylinder when referred to the high-pressure area, all from a single fuel injection. Instead of 60 to 70 pounds net mean effective to the crank, delivering its power through a few degrees only of one stroke in four, in the compound we have two net mean effectives, each of 300 or 400 pounds per square inch, succeeding each other and covering two strokes out of the four from a single fuel injection, giving very much better crank-effort distribution for power purposes.

The point of paramount interest is that these two large blocks of power are secured *not by any material increase of pressures,* but by using large quantities of power gases, and "hanging on" to the pressures we have in those gases throughout practically two complete strokes, clear across the card twice, thus abstracting much more of the power they contain before exhausting. Suppose these to be 330 pounds per square inch each. Added they make 660, which is easily ten times 62 pounds, a net mean effective not infrequently met with in ordinary Diesels. In an engine of simple construction giving ten times the net mean effective to its crankshaft and well distributed, there should be no good reason why it should weigh more than one-tenth the weight of the present Diesel.

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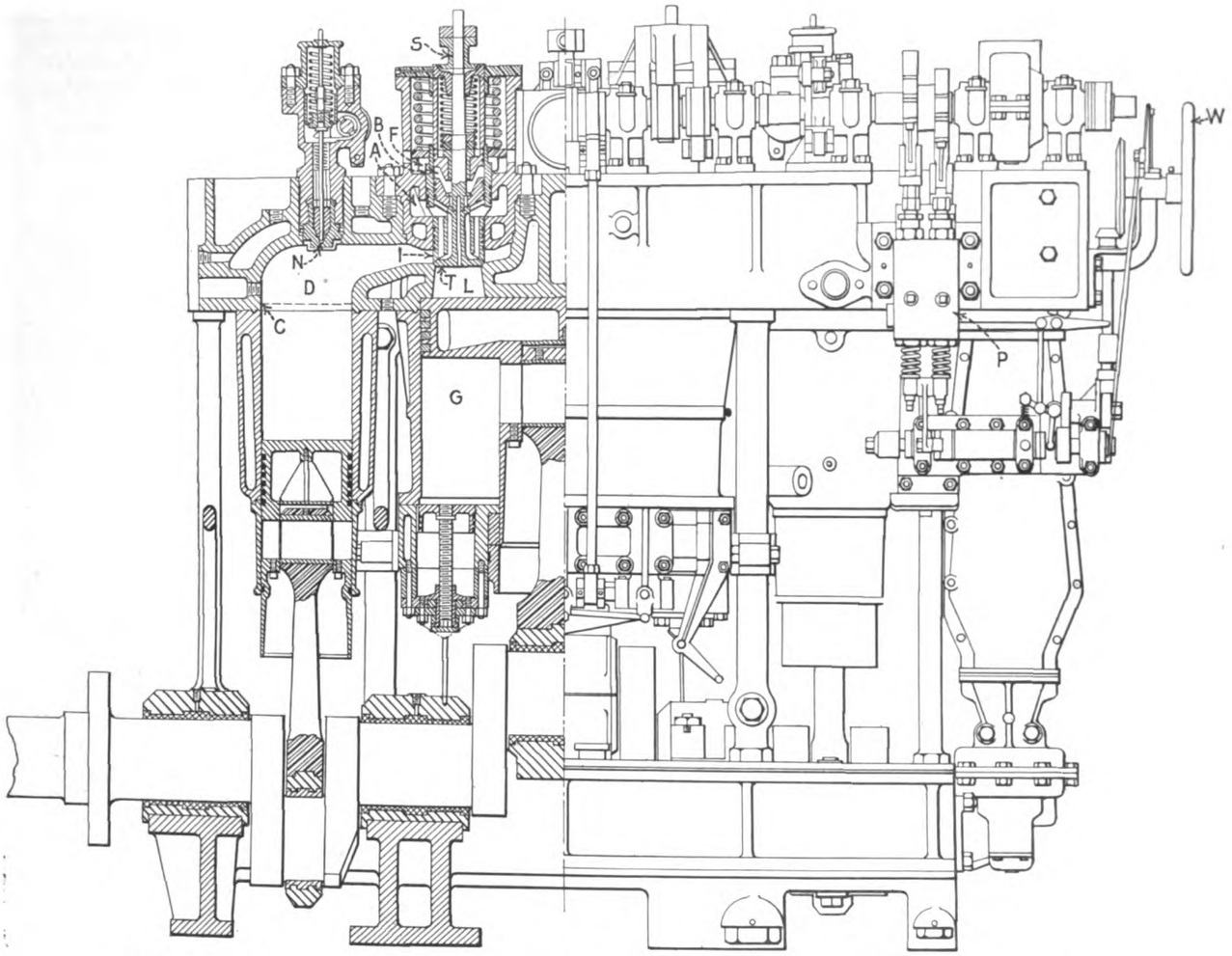

Fig. 2.—Longitudinal Section and Elevation of Sperry 10:1 Compound Engine Built for Heavy Duty

The power gases work in the Diesel about 120 degrees of arc and in the compound 315 degrees, or 2.6 times as long; or, considering the points of "cut-off" in each, the true expansion curve is 3⅓ times as long, which accounts for its large mean effectives and higher economies.

Proper Ratio for Compounds

As to the proper ratio for compounds; engines of 10:1 ratio of low-pressure to high-pressure cylinder areas, also 8:1 and 6:1 have been made, operated and studied, the smaller ratios being at present considered more desirable. The weight factor does not change materially with changes in ratio in this region. The low-pressure piston operates two cycle. The power distribution and the weight of the reciprocating parts both equalize best at about 6:1. This makes a perfectly balanced unit, the end masses equaling and also moving oppositely to the central. The two full power impulses following each fuel injection are also about equal. Thus full *four-cylinder performance* is secured with only three cranks and two extra power impulses are delivered on the induction stroke, making six power impulses for each cycle.

Another unusual advance should be noted, viz., complete reversibility and self air starting are secured without additional valves or cams over the simple, one way engine without air starting, there being no difference in this regard. Again comparing the full-reversing, air-starting compound unit with a similar four-cylinder Diesel of any prominent make, delivering the same number of primary power impulses to the crank, the latter has 16 valves and 32 cams. The former operates the same cycle with two extra power impulses over the Diesel with 5 cams driving 7 valves.

Three-Stage Compressor Eliminated

Doing away with the three-stage air injection pump, its intercoolers and general complexity, is another important simplification. One United States builder stated recently that an excess of 11 percent of the entire power of the engine is absorbed for driving these pumps.

As stated, solid injection only is used in the compound and the engine is controlled entirely by the fuel, viz., by lifting and timing the fuel valves. The constant-pressure trunk system is used with an accumulator in the line, the pumps simply working constantly against loaded relief valves which may be adjusted at will. Two very small plungers are constantly acting. The pistons, accumulator and the fuel valve stems are ground in and require no packing.

Types of Compound Engines

Fig. 1 shows a 10:1 compound engine, built for heavy duty. Although this is a small marine type with high-pressure cylinders 7-inch by 11-inch running at 400 revolutions per minute yet the size of the crank pitman-end in the lower center of the engine reveals the ruggedness of these parts. The fuel pumps are also shown here and the connection to the governor. The camshaft is on a shelf at the top of the engine to one side and is driven by skew gears. The electric generator forming the full load of this engine is shown in the background and one of the transfer valves with its bonnet cover stands on the floor in front of the

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engine. The comparatively small size of the engine, although in the foreground, is notable. The compound works at a piston speed of about 700 feet per minute and its generator would be still smaller in comparison, should it be worked at the piston speed of about 900 feet per minute of the large engine.

The large size and weight in the Diesels extend to all makes in somewhat different degrees. A line of Diesels made in the United States is reported to weigh 512 pounds per brake horsepower, while the compound in Fig. 1 weighs less than 30 pounds per brake horsepower.

INTERNAL CONSTRUCTION OF THE COMPOUND

Fig. 2 shows an elevation to the right of the center, and longitudinal section to the left, of the engine shown in Fig. 1. The two high-pressure or combustion pistons on their out stroke are at the ends, and in the center is the low-pressure at its extreme in stroke. The sturdy construction is indicated by the size of the crankshaft, about 50 percent larger than in any other combustion engine of which the author has knowledge, approaching, as it does, the bore of the combustion cylinders themselves. The fuel pumps *P* and the control and manipulating wheel *W* are shown in elevation to the right. To the left the large dome of clearance *D*, forming the combustion chamber of the compound, stands out in marked contrast to standard Diesel practice, which is shown by the little space *C* between the solid horizontal line at the base of the clearance and the dotted horizontal line just above. The dome is large and forms an upward extension of the combustion cylinder, extending also to the right in a large sweep surrounding the transfer valve *T* which seals the transfer port *L*. The sleeve-like induction valve *I* is shown seated on top of the transfer valve and is controlled by the cam-operated fork *F*. The transfer valve and sleeve are lifted by a fork not shown, located in thimble *S* near the top of the stem. The first-stage annular compression pump *G* surrounding the trunk piston below the low-pressure piston proper, delivers its air to a small receiver, which in turn discharges to the cored port *A* surrounding the induction sleeve *I*, the cooling action of which has been described. The little balancing cylinder *B* sustains a permanent connection with the low-pressure cylinder. The solid-fuel injection valve and nozzle *N* are placed approximately over the center of gravity of the large masses of air in the clearance dome *D*.

It is understood that the two high-pressure cylinders are operating four cycle, one 360 degrees back of the other, discharging alternately into the low-pressure, which therefore works two cycle and delivers power on each down stroke.

ORDINARY STANDARD CONSTRUCTION AND HIGH MECHANICAL EFFICIENCY

The illustrations show the simplicity of the details, there being no part with which the ordinary engine builder is not perfectly familiar, nothing about the cylinders, pistons, rings or valves that lies outside ordinary good engine practice and construction. The radiating fins on the valves and the piston clearances and tolerances are the only points that vary to some small degree from the best Diesel practice.

A point of interest arises regarding the mechanical efficiencies of the compound. The two high-pressure cylinders in this case might be considered as constituting a two-cylinder Diesel. By separating them and adding one crank and the low-pressure piston between them, an increase of no less than seven times the power to the crankshaft is realized in this engine. Pursuing this one step farther, to obtain this increase of power at the shaft, it is perfectly apparent that we have not added, nor are we driving, seven times the machinery. We are driving probably about twice the machinery, giving one apparent reason for the very high mechanical efficiency observed in this engine. These efficiencies have again secured an additional check by motoring the engine and taking a number of sets of cards, in several instances indicating as high as 93 percent mechanical efficiency.

PORT VELOCITIES

In Fig. 2 the transfer port *L* to the low-pressure piston has only about one twenty-fourth of the area of the piston. The question naturally arises, what about wiredrawing through this port? This has been closely investigated and it is found that at 1,000 feet per minute piston speed, the velocities rise to 200 feet per second only at a point near the greatest velocity of piston travel. This comes from the fact that by the time the center of the stroke is reached, where the velocities are highest, the expanding gases delivering the power find themselves very largely on the low-pressure side and therefore are not required to traverse the port. It is well known that no wiredrawing, as such, exists at the velocities named.

FIELD OF USEFULNESS OF THE NEW PRIME MOVER

To engineers versed in the problems of selecting and designing prime movers, the advantages of the compound combustion engine are readily apparent. Its light weight for a given power with resulting low first cost and capital charge, the low costs for foundations, the high speeds with consequent low costs for connected generators, the small space required and the simplicity and economy of operation are important reasons for suggesting new fields for this prime mover, which has been proven of practical value in a long series of tests under working conditions.

In connection with the development of the compound engine for marine purposes, and in order to provide any Diesel type of engine with speed flexibility equaling the reciprocating steam engine, there has been developed an electromagnetic clutch operating on an entirely new principle.* This clutch furnishes a positive yet completely elastic drive brought about by a unique correlation of two oppositely applied forces, each producing powerful torques induced and brought under perfect control by the application of a very small amount of external electrical energy. The drive has no moving parts, and is rugged and simple in design and construction. It is small for its power and therefore capable of being built in practically any range of horsepower.

CONCLUSION

In combustion engines the high-pressure principle is scientifically correct, having brought to the prime mover its choicest heritage, as stated, viz., the highest thermodynamic efficiency known. Broadly speaking, however, these various engines represent only the early stages of the development. The best of present embodiments in simple Diesels, though much refined as to certain details, are, generally speaking, extremely crude, their design is based on such a ridiculously small quantity of air per charge, and their material efficiency is too low to be tolerated. Further, very large structures are required to produce small powers.

This paper presents the results of research extending over a series of years, looking to the correction of these and other serious faults and to very greatly increasing the material efficiency. This is found to bring with it a number of distinct advantages and, it is believed, marks a definite advance. It is high time that this next logical step be taken so that the full capabilities of the high-pressure principle in combustion engines may be realized in service by the adoption of modern multi-stage methods. It is believed that the results for the first time announced in this paper warrant the prediction that engines employing the multi-stage or compound principle will occupy a dignified place in the combustion-engine art. If this principle should assume leadership, it will of course only be because of its demonstrated practical usefulness and general merit.

*For description see MARINE ENGINEERING AND SHIPPING AGE, November, 1921, page 817.

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in This Department

Conducted by James L. Bates

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Marine Engineering Problems

Q.(1138).—(1) In putting hydrostatic pressure on steam boilers where the capacity of the pump and steam supply is limited, how do I find the amount of power lost through friction? We often have a pump that fails to put the pressure required on boilers for test, but we are unable to figure the size of the pump to install for this work of overcoming friction losses.

(2) Suppose the coils of a fuel oil heater are full of oil at 80 degrees Fahrenheit, and all valves shut to prevent escape of oil and steam is turned in the heater to heat the oil up to 250 degrees Fahrenheit, what will be the pressure in the coils? Please give me the formula for working this problem at various pressures and temperatures.

(3) Please name the strakes of steel or iron vessels and state where they are located.

(4) What should be the thickness of the lead sleeve in the stern tube of a wooden tugboat, and how is it made and put into place?

(5) What effect on the valve gear would be caused by moving the eccentric ⅛-inch forward on a shaft of 16 inches diameter? I want a formula for working these problems for various movements of eccentric and different sizes of shaft.

(6) What is the greatest wear down of tail shaft allowed by the United States Steamboat Inspection service and American Bureau of Shipping?

A. (1138).—(1) The writer knows of no way to figure the amount of power lost in a steam reciprocating pump through friction, but would suggest that on a basis of the test pressure and plant boiler steam pressure being equal, the steam piston area should be at least 30 percent greater than that of the water piston. This allowance takes care of not only the mechanical loss in the pump but for pressure drops due to leakage by pistons, valves and joints. The following general formula should give satisfactory results:

$$D = \sqrt{\frac{1.3\, d^2\, p}{P}}$$

where:

p = test pressure to be placed on boiler, pounds per square inch.

P = steam pressure on plant boiler, pounds per square inch.

d = diameter of pump water cylinder in inches.

D = diameter of pump steam cylinder in inches.

(2) This problem does not lend itself readily to solution by formula due to the uncertain conditions which enter into it. The only reliable method would be by actual test, reading the resulting pressure from a calibrated pressure gage.

(3) On a typical shell expansion or midship section the various strakes of plating are designated by letters, beginning at the garboard strake and lettering out around the bilge and up the side, ending with the sheer strake, thus A, B, C, etc. The letter I is generally omitted to avoid confusion. The flat keel strake, or plate, is marked F. K.

In addition to the designations just noted, some strakes are known by names which, by reason of long association with certain portions of the vessel, identify the strake immediately with those portions. The principal among the strakes so named follow together with a description of each.

Flat plate keel, a series of plates of extra thickness which forms the strake running fore and aft along the vessel's bottom at the center line.

Sheer strake, the strake of shell plating that runs along the level of the main or upper decks. Plates running along the level of the lower decks are not called sheer strakes. See "Shipbuilding Cyclopedia," page 121.

The keel and sheer strakes are important strength members because of their distance from the neutral axis of the ship. They are generally made thicker than the other strakes of side or bottom plating.

Bilge strake, a strake of outside plating running along the bilge.

Bottom strake, a strake of bottom plating lying between the garboard and bilge strakes.

Garboard strake, the strake of bottom plating adjacent to the keel. The garboard strakes are frequently made heavier than the other bottom strakes as they work closely with the keel to form the backbone of the vessel.

Topside strake, the strake next below the sheer strake.

There are other strakes which are named because of certain outstanding features or certain work done.

Doubling strake, a strake of plating fitted in conjunction with a regular strake. The sheer strake and keel are frequently doubled to provide extra strength.

Drop strake, a strake which is terminated short of the bow or stern due to the decreasing girth of the ship as the ends are approached.

Inner strake, a strake adjacent to the molded frame line.

Outside strake, a strake which laps onto the two adjacent inner strakes.

The last two terms apply to the so-called "in and out" system of plating.

(4) The dimensions of the lead stern tube are, of course, dependent upon the size of the vessel. In a wooden tug of 88 feet overall length, a hole or shaft well 8½ inches in diameter was driven through the shaft log. This was fitted with a lead sleeve or lining ¼ inch in thickness. The lead tube itself was in one piece fitted singly between the two portions of the shaft log. At its forward and after end it was expanded over the stuffing box and stern bearing, respectively.

In a smaller, higher speed boat with which the writer is familiar the bore of the shaft log is 4½ inches and the thickness of lead sleeve ⅛ inch.

(5) The following conditions are assumed:

(*a*) The piston for the cylinder in question is at the bottom of its stroke.

(*b*) The crank turns anti-clockwise when standing at the forward end of the engine looking aft.

(*c*) Steam taken over ends of valve.

(*d*) Engine has open rods, i. e., with the piston in position (*a*) the center of the ahead eccentric would be to the right of the engine vertical center line and above the horizontal shaft center line at a distance equal to the angle of advance.

(*e*) The eccentricity, or half the valve travel, equals 5 inches.

(*f*) The angle of advance or the angular distance which the center of the ahead eccentric is above the horizontal shaft center line.

(*g*) L = length of eccentric rod, i. e., center of eccentric to center of link block pin, equals 96 inches.

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r = eccentricity = 5 inches.
R = half the shaft diameter (given) = 8 inches.
m = lineal movement along shaft (given) = ⅛ inch. This movement is to be forward, i. e., in the direction the shaft rotates.
ϕ = 40 degrees.
Δ = angular movement of eccentric around shaft in degrees corresponding to "m" =

$$\frac{360\ m}{2\pi R} = \frac{360 \times .125}{2 \times 3.1416 \times 8} = .895 \text{ degree}$$

$$= 53.7 \text{ minutes.}$$

θ = new angle of advance = $\phi + \Delta$ = 40 degrees + 53.7 minutes.
a = vertical distance from horizontal center line of shaft to center of eccentric before movement = r sin ϕ = 5 × .6428 = 3.214 inches.
a_1 = vertical distance from horizontal center line of shaft to new center of eccentric after movement = r sin θ = 5 × .6546 = 3.273 inches.
b = horizontal distance from the vertical center line of engine to the center of the eccentric before movement = $\sqrt{r^2 - a^2} = \sqrt{(5)^2 - (3.214)^2}$ = 3.831 inches.
b_1 = horizontal distance from the vertical center line of engine to the new center of the eccentric after movement = $\sqrt{r^2 - a_1^2} = \sqrt{(5)^2 - (3.273)^2}$ = 3.78 inches.
l = vertical distance from the center of the eccentric, before movement, to center of link block pin = $\sqrt{L^2 - b^2} = \sqrt{(96)^2 - (3.831)^2} = 95.9235$ inches.
l_1 = vertical distance from new center of eccentric, after movement, to center of link block pin = $\sqrt{L^2 - b_1^2} = \sqrt{(96)^2 - (3.78)^2} = 95.9256$ inches.
d = distance which link block pin has been raised by moving the eccentric forward ⅛ inch around the surface of the shaft = $(a_1 + l_1) - (a + l)$ = (3.273 + 95.9256) − (3.214 + 95.9235) = .0611 inch = 1/16 inch approximately.

This dimension "d" is also the amount which the valve is raised or, in other words, it is the amount by which the bottom steam lead would be increased. The top lead would, of course, be increased by the same amount and cut-off, admission, compression and release will all occur earlier in the stroke of the piston as a result. Had the shifting of the eccentric been in the opposite direction, the bottom steam lead would have been decreased and all events would have occurred later in the stroke.

By using the above method of procedure, the amount by which the steam lead is affected may be calculated for any movement of the eccentric on its shaft, for any diameter of shaft or throw of eccentric.

(6) There is no express rule under the Steamboat Inspection Service as to the percentage of wear down on a tail shaft. The local inspectors having original jurisdiction use their best judgment, based on practical experience.

The American Bureau of Shipping, see section 45 of the rules, provides as follows:

"Tail shafts are to be drawn for examination at least once every two years, but when liners are fitted solid in one length, the shafts need only be drawn once every three years.

"When the after bearing is worn down ¼ inch with shafts not exceeding 9 inches in diameter; 5/16 inch when over 9 inches and not exceeding 12 inches and ⅜ inch with shafts over 12 inches in diameter, the bearing is to be rebushed."

Horsepower of Multiple Cylinder Engines

Q. (1141).—Will you give some information in regard to figuring the indicated horsepower of triple expansion engines of three and four cylinders and quadruple engines, with regard to vacuum and back pressure. I refer to the difference that these will make to the mean effective pressure that is obtained from the indicator diagrams.

A. (1141).—"The term 'back pressure' is usually applied to the pressure of the exhaust from the low-pressure cylinder, although of course there is back pressure in the other cylinders due to the exhausting of the steam into the next cylinder. It is of importance to keep the back pressure in the low-pressure cylinder as low as possible, as this pressure acts on the piston in opposition to the steam pressure. In order to keep the back pressure low, care should be taken in the design of the low-pressure cylinder to make the exhaust passages and exhaust pipes of ample area and free from obstructions and abrupt turns. The back pressure in a well designed low pressure cylinder should not exceed 3 to 4 pounds absolute. It may be found from the indicator card and is usually 2 pounds more than the pressure in the condenser as shown by the vacuum gage." For the foregoing, see page 826, "Marine Engineer's Handbook," by Sterling.

Considerable attention has been paid during recent years to the design of condensing apparatus having high vacua. Bragg in "Design of Marine Engines and Auxiliaries," page 13, writes: "The effect of vacuum upon economy was investigated in certain experiments carried out by Professor Weighton. He found that the number of pounds of steam per brake horsepower was least at a vacuum of 26 to 28 inches, but that the number of heat units, working from the high pressure steam chest to the hot well per brake horsepower was least at 20 inches vacuum. While the horsepower of the engine is increased by increasing the vacuum, it causes the temperature of the hot well to be lower, and it is possible to carry the cooling to such a point that the coal per brake horsepower is increased.

"Another point brought out by these experiments was that in going from 26 inches vacuum to 28 inches vacuum, the mean referred pressure was not increased by the equivalent of 2 inches of mercury but by something less than 2 inches.

"It was also shown that the effect of increased vacuum was not confined entirely to the low pressure cylinder but reached back into the intermediate and high pressure cylinders with the result that the steam consumption instead of remaining constant per revolution increased as the vacuum increased. Both of these results are probably due to the increased range of temperature in the cylinders, causing an increase in the initial condensation. This effect would probably be greater with less stages of expansion and less with a greater number of stages."

In determining the size of a multiple cylinder engine to develop a given horsepower the size of the low pressure cylinder is first ascertained and the other characteristics fixed with this as a starting point. The "mean effective pressure" is the mean pressure of admission and expansion as derived from the indicator card or the total area of the indicator card divided by the length of stroke. The "mean referred pressure" is the mean effective pressure that would be necessary to do the combined work of all the cylinders in the low pressure cylinder alone. In the actual indicator card or diagram the lower boundary of the figure is termed the "back pressure line." The closer that this line can be brought to the zero line representing perfect vacuum the greater the area of the card and the higher the value of the mean referred pressure. A small reduction in back pressure produces an effect upon engine efficiency equal to that of a much larger increase in initial pressure. In the case of a 5,000 indicated horsepower three-cylinder triple expansion engine, the change of back pressure by one pound effected a reduction of 1 inch in the diameter of the 94-inch low pressure cylinder.

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PERSONAL MENTION

LAWRENCE J. BRENGLE was appointed acting manager of the United States Salvage Association at a meeting of the directors on December 15. Mr. Brengle succeeds Charles R. Page, whose resignation took effect December 31, when he became manager of the Atlantic marine department of the Firemen's Fund Insurance Company. Mr. Brengle was formerly the underwriter of Syndicates "B" and "C" of the American Marine Insurance Syndicates in which capacity he will continue, devoting sufficient time, however, to the supervision of the administration of Syndicate "A" and of its operating agent, the United States Salvage Association, Inc. Mr. Brengle has had wide experience in the handling of the affairs of wrecked and damaged vessels and is familiar with shipping of the Pacific as well as the Atlantic coast, which fits him particularly to administer the affairs of the Salvage Association.

JOHN H. TROWBRIDGE, formerly with the firm of Marsh & McLennan and recently chief clerk of the American Marine Insurance Syndicates, will have direct supervision of the administration of the affairs of the United States Salvage Association, Inc., under Lawrence J. Brengle, acting manager of the association.

THOMAS L. CLEAR, whose appointment as treasurer of the United States Shipping Board Emergency Fleet Corporation was announced in the November issue of MARINE ENGINEERING AND SHIPPING AGE (page 860), received his early training in banking and railway service. He was an assistant to General Goethals in 1908, having been appointed assistant auditor to reorganize the fiscal operations of the Panama Canal and Panama Railroad Company. In 1914 he was appointed by General Goethals as collector of the canal and later became treasurer of the Panama Railroad Company. While collector, Mr. Clear organized a plan by which ship operators were able to have ship charges paid by their local banks wherever located to a correspondent bank at the canal, greatly facilitating the movement of vessels. The system which now prevails enables an operator at any part of the world to pass his ship through the canal without any deposit and, unless the ship is in need of fuel or repairs, she is not required to stop in approaching and passing through the canal except when in the locks. Mr. Clear left the canal in the summer of 1918 and was sent to Europe by the War Department in the capacity of an inspector general, his work being confined to the supervision of financial affairs of the American Expeditionary Forces. He returned to the United States in September, 1919, and was appointed comptroller of the United States Shipping Board by Judge John Barton Payne, its chairman, but declined the appointment and, at the request of Governor Harding, returned to the Panama Canal and resumed his former position. After fifteen months' service he accepted an appointment in the United States Army as an inspector general, but resigned his commission October 7 to become treasurer of the United States Shipping Board Emergency Fleet Corporation.

Major T. L. Clear

G. O. MACCONACHIE, in addition to his duties as assistant to Joseph W. Powell, president of the United States Shipping Board Emergency Fleet Corporation, has recently been given entire supervision of the personnel of the corporation. He was born in Detroit, Mich., and received his education at the Central High School of that city and at the University of Michigan. In 1919, he entered newspaper work and served on the staffs of various Detroit newspapers until 1914 when he entered the employ of the Campbell-Ewald Company, advertising agents. In 1917 he joined the Harlan plant at Wilmington, Del., of the Bethlehem Shipbuilding Corporation and was appointed head of the service department. During the three and a half years he was with this corporation, he supervised the general publicity work at Sparrows Point, Md., at the Harlan plant, at the Moore plant, Elizabeth, N. J., and at the Fore River plant, Quincy, Mass.

G. O. MacConachie

CHARLES KERR, formerly with the Bethlehem Shipbuilding Company, has been appointed outside marine superintendent for the Main Iron Works, San Francisco, Cal.

C. A. ASKEW, vice-president and general manager of the Atlantic Gulf and Pacific Steamship Company, will have charge of the office affairs on the Pacific coast, succeeding Thomas J. Wade, who recently resigned.

A. P. HAMMOND, who has been Pacific coast manager of the Luckenbach Steamship Company for five years, recently resigned. Lewis Luckenbach will handle the affairs of the company on the Pacific coast for the present.

C. L. CHRISTENSON, for the past five years connected with the New York offices of the International Mercantile Marine Company, has been appointed manager of the Cleveland passenger office of this company which has recently been opened.

J. V. C. COMFORT has been appointed manager of the Pacific Mail Steamship Company's Panama Line, according to an announcement made by Thomas Graham, vice-president and general manager. Mr. Comfort is succeeded as operating manager by Thomas James. Both these men have been with the Pacific Mail Steamship Company for many years.

COMMANDER L. M. STEWART has been appointed successor to William Glassford in charge of the United States Naval Hydrographic office with headquarters in the Merchants Exchange Building, San Francisco, Cal. For the past few months Commander Stewart has been in charge of the eleventh destroyer division at San Diego; before this time he was captain of the destroyer *Varnall* with the Asiatic Squadron. During the war he commanded the destroyer *MacKall* and was also in charge of the mine assembling base at Inverness on the coast of Scotland.

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Shipping and Ship Operation News

Changes in Steamship Routes — Passenger and Freight Activities—Port Plans and Other Notes of General Interest

Chartering of Tankers Profitable To Shipping Board; Bare Boat Plan Returns $50,000 a Month Revenue

J. Barstow Smull, Vice-President of Emergency Fleet Corporation, Reports on Six Months' Activities—Losses in Voyage Operations Being Steadily Diminished

J. BARSTOW SMULL, vice-president of the United States Shipping Board Emergency Fleet Corporation, in charge of allocations and charters, has issued the following statement regarding the work accomplished in his division in the past six months:

"I found on assuming my office in July that there was no one in the whole organization who knew anything about chartering. Charters were being put through that were absolutely detrimental to the Board's interests. I selected the best man I could find in the chartering trade to take over this most important work and stationed him in New York. Since then we really have had few slip-ups whereby the Board suffered.

"The chartering of tank boats has been very profitable and is still going on today. Of course, the general trades have been so poor that it has not paid to charter vessels and I have not chartered any vessel for general cargo business.

"We have been struggling hard with the bare boat charter as the times have been against us, but we are most pleased to say that we have twenty-three (23) vessels under bare boat charter which turn in a revenue of about $50,000 a month. With an improvement in the freight market at all, undoubtedly we will have the opportunity of putting forward quite a few boats on time charter basis."

Discussing the charter situation on the Atlantic Coast, Mr. Smull continued:

"Some time ago the Board of Trustees decided that it was not fair to privately owned tonnage on our Atlantic Coast to charter our vessels on a bare boat basis to compete against established lines in the coastwise trade. There is no doubt that a ship on a bare boat charter at 50 cents a ton can very successfully compete with privately owned tonnage bought at high prices, for the private owner has to take into consideration in making his rates, his overhead expenses, his depreciation, interest on his money and Marine Insurance.

"We are mandated by the Jones Bill not to interfere with privately owned established trades, and in following out the requirements of the Merchant Marine Act it is necessary for us to refrain from chartering our vessels on any sort of a time charter basis where they would be thrown in competition with those vessels privately owned."

The vice-president then briefly reviewed the activities of the Contract Department in his division:

"This department has charge of the working out of all charter parties and contracts effected on Shipping Board tonnage.

"It might be interesting to the public to know that since the Board has been in office we have been able to collect more than $178,000 in demurrage. Formerly these demurrage claims either laid dormant or were put into the hands of the legal department, where it would take anywhere from three to five years to get them tried out in the courts.

"We have been able to settle these cases either by mutual agreement or by arbitration. My department at present has under active negotiation for settlement more than $300,000 worth of these claims. Altogether there seems to be about $2,000,000 of these demurrage claims against American shippers, and about $3,000,000 against foreign governments which will have our attention in due course."

Regarding withdrawals and allocations, Mr. Smull said:

"On July 24 there were 75 active managing agents of the Fleet Corporation operating 674 steel ships. Of this number of agents there were 12 acting as tramp operators, having a total of 125 vessels in service. The losses were running from $5,000 to $25,000 per round trip voyage to Europe, approximately $1,250,000 being the loss in voyage operations last June.

"On January 1, 1922, there will only be 43 active agents handling 321 ships. All tramp steamers have been withdrawn. The losses in voyage operations in October, which is the last month for which we have a report, had been cut to $400,000, and they are still being diminished.

"From July 20 to the present date 526 steel cargo carriers have been withdrawn from service, and 173 are allocated as follows: Eighty for berth service, 13 for bulk cargoes, and 80 as substitutes for the betterment of services and the saving of repairs. This leaves a net number of 353 steel cargo and passenger vessels that were tied up from July 20 to date."

FREIGHTER POPULAR

West Lewark Clips 11 Days from Foreign Voyage Schedule

When the *West Lewark* was delivered to the United States Shipping Board by her builders, the Los Angeles Shipbuilding & Dry Dock Company, last July, and was chartered by Williams Dimond & Company for Pacific-European trade, she attracted considerable attention at northern ports because of her being the first Pacific coast built vessel of her type and one likely to prove particularly popular with shippers.

The *West Lewark* left the west coast at the end of August with full cargo for Glasgow, Liverpool, London, Antwerp, Rotterdam and other ports. According to the schedule laid out for her she should have returned to Los Angeles harbor November 14. She reached here, however, Friday, November 11, and by Saturday, November 12, she had unloaded her cargo at this port and had again cleared for northern ports. Not only this, but while in Europe she had been diverted to Liverpool for return cargo, thus taking up eight days not allowed for her schedule. Captain Ansell, therefore, claims to have clipped his schedule eleven days and to have brought his ship back after traveling 20,000 miles without a stop, and in that perfect condition which reflects the utmost credit upon the port of her registry and the work of the organization that built her.

With full cargo the *West Lewark* averaged 11.95 miles per hour in the run from Cristobal to Glasgow. Her revolutions were 75.6, and her average oil consumption was .99 barrels per mile.

World's Largest Steamship to Sail from New York on May 20

Following the return from abroad of P. A. S. Franklin, president of the International Mercantile Marine Company, the White Star Line has announced that the 35,000 ton *Homeric* will make her first return voyage from New York on March 1, 1922, and that the 56,000 ton *Majestic*, the world's largest steamship, will make her first voyage out of New York on May 20. These two steamers, with the *Olympic*, will maintain a regular weekly service between New York and Southampton via Cherbourg.

The addition of the *Majestic* and *Homeric* to the Southampton service releases the *Adriatic* for the New York-Liverpool service, where she will operate with the *Celtic*, *Cedric* and *Baltic* in a regular weekly schedule. These four steamers, in addition to passenger accommodations, have an unusually large cargo capacity.

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Plans Maturing for New Direct Steamship Line Between the Hawaiian Islands and Los Angeles, Cal.

Steamers Aeolus and Huron Allocated to Los Angeles Steamship Company for Expansion of Service to Include Passenger and Freight Route to the Islands

PLANS for the establishment of a direct steamship line between the Hawaiian Islands and Los Angeles have been under development for several weeks past. Announcement of these plans was made following the launching, at the plant of the Los Angeles Shipbuilding & Dry Dock Company, of the *West Chopaka,* 35th and last steel freighter built by this concern for the United States Shipping Board and now under charter to Struthers & Barry.

Following the launching of the *West Chopaka,* Fred L. Baker and Erle M. Leaf, respectively president and vice-president of the shipbuilding company, entertained some three hundred guests on the steamship *Harvard,* taking them over to Catalina. Among the guests were men representing most of the important civic and business interests of Los Angeles. At a meeting held in the smoking room of the *Harvard* the plan to expand the interests of the Los Angeles Steamship Company and include a high class freight and passenger service with the Hawaiian Islands was fully discussed. Shortly after this meeting Mr. Leaf went east, and placed before the Shipping Board and administration officials the definite plans of his associates, requesting the allocation by the United States Shipping Board of two ex-German liners.

December 1st, despatches from Washington announced the success of Mr. Leaf's errand and the allocation to the Los Angeles Steamship Company of the *Acolus* and *Huron,* now being operated by the Munson Line on the South American run, but shortly to be turned back to the Shipping Board and through them to be delivered to the Los Angeles people early in 1922.

The *Aeolus* and *Huron* are 15-knot, oil burning vessels, originally in the Atlantic service between Bremen and New York, and then known as the *Grosser Kurfurst* and the *Frederich der Grosse.*

The *Acolus* is 560 feet long between perpendiculars, and the *Huron* is 528 feet. Each has capacity for about 400 passengers, and each is equipped with gyroscope, being therefore considered as exceptionally steady and claimed to be great favorites with the sea-going public.

Certain changes and improvements planned for these vessels by the Los Angeles Steamship Company will be made upon their arrival at Los Angeles harbor, but it is understood that having but recently been thoroughly re-conditioned, decorated and furnished, the contemplated re-equipment and alterations will not take long, so that the new service to Honolulu is expected to be started during the coming spring.

The importance of this service to the Hawaiian Islands and to the entire Los Angeles community cannot be well overestimated. A "home owned" line of ships, recognized as being of the very finest class, is of paramount importance to any port. It means business for the port out of all proportion to that which comes from vessels merely "calling" at the port. To the Hawaiian Islands it means greater benefits since this direct service will be of incalculable advantage in developing tourist travel as well as providing a sure and regular service for every day business between these two points. Instead of being, as it is today, mainly a point of call between California and the Orient, Honolulu will be a terminal port of regular service of the highest class with Los Angeles and that vast tourist travel which Southern California has built up.

In the course of his negotiations in the East, Mr. Leaf had the honor of an interview with President Harding, who expressed himself as being particularly interested in the development of plans which would further the interests of the Islands and place them in closer touch with the Pacific Coast.

"NO. 80" ENTERTAINS

Ocean Engineers Greet Santa Claus—President Martien Re-elected

A very successful Christmas smoker and general "get together" meeting of Ocean Marine Engineers Beneficial Association, No. 80, of New York city, was held in their club rooms at 15 Whitehall Street, on Tuesday night, December 20, 1921. The affair was formally opened by the introduction to the assembled members and their guests, which numbered about 450, of Mr. E. Martien, the president of the local. The introduction was made by Mr. B. L. Todd, better known among the boys as "our Bert," the business manager.

The entertainment consisted of many musical numbers rendered by accomplished musicians and fellow members, story telling by George Smith, several very good three-round bouts, a visit from Santa Claus and refreshments. The speaker of the evening was the Honorable Peter J. Brady, Commissioner of Records, of the city of New York, and an official of the Printers' Union, who gave a very interesting account of the trials that the several labor organizations had gone through during the past year of depression, but left all with the impression that the "worst was over."

Stephen J. Kelly, president of Allied Printers, State of New York, sang several ballads, and Mr. Todd announced that Mr. Martien had consented to be president for the coming year.

STEAMSHIP INTERESTS

According to officials of the Mallory Steamship Company, a new ten-day steamship service between Tampa and New York will be inaugurated with the sailing of the Mallory steamer *Altamaha.* The company proposes to use its own boats in this service and to release the boats of the Shipping Board which have been in use by the line since the war.

The Robert Dollar Steamship Company will inaugurate a freight service between Seattle, Vancouver, B. C., and San Francisco, on the Pacific Coast and ports of the Far East, on January 10, 1922, according to an announcement made public by officials of the company. The three ships to be used in this service are the *Harold Dollar, Bessie Dollar,* and *Melville Dollar.*

The tanker H. M. Storey has had its trial trip under the supervision of Captain Herbert Kirst, of the Bethlehem Shipbuilding Corporation, San Francisco, Cal. She is the second of three tankers to be completed by the Bethlehem Company for the Standard Oil Company. All three are of the same type and of 15,000 deadweight tons each, with a carrying capacity of 120,000 barrels of oil and a speed of 11 knots.

Following the disbanding of the firm of Struthers & Dixon, and the closing of their Seattle and San Francisco offices, C. S. Holmes, former resident agent for the firm at Seattle, has announced the formation of the C. S. Holmes Shipping Company of Seattle, with offices at 321 L. C. Smith Building, Seattle, Wash. The new firm will be agent at Seattle for the Intercoastal Sea Carriers, Inc.

It is announced that the State Railroad Commission, San Francisco, Cal., has authorized the Bay Transportation Company to issue not exceeding $127,500 of its common stock and to assume the payment of indebtedness amounting to $207,562.93. The Bay Transportation Company was recently organized for the purpose of taking over the business of E. V. Rideout & Company. The company operates steamers and barges in San Francisco Bay.

Indicative of better shipping activity at Philadelphia, it is announced that two new services will be established from the port of Philadelphia by the Hudson Shipping Company. The Export Steamship Corporation, 25 Broadway, New York, will inaugurate a line to Constantinople, Smyra, and Alexandria with the freight steamer *Blair,* and the Baltimore Steamship Company, Inc., will inaugurate the second service with the steamer *Coclleda.* Reductions in class and commodity rates between Norfolk and Boston and Providence have been put into effect by the Merchants & Miners Transportation Company. New rates on fruit and vegetables are from 5 to 10 per cent lower than those hitherto in force, and oyster rates are a little more than 5 per cent lower than formerly. Rates on northbound forest products, knit goods, and peanuts are also revised downward. Southbound rates on iron and steel products have been cut.

A reduction of $21.50 in third class passenger rates to Hamburg and $28.50 to

(Continued on page 74)

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Shipbuilding and Terminal Development

What the Shipyards Are Doing—Dry Dock Notes—Launchings—New Engineering Projects

City Island, N. Y., Shipyard Gets Contract To Build Distinctive Type Of Houseboat Having Oil Engines

Plans and Specifications Prepared by Henry J. Gielow, New York Naval Architect, Provide for Capable Seagoing Craft Also Suitable for Florida Waters

AT the yard of Kyle & Purdy, City Island, N. Y., work has been commenced on the construction of a steel houseboat for Mr. Louis H. Eisenlohr, of Philadelphia, member of the Philadelphia, Corinthian and other eastern yacht clubs. Plans and specifications for this yacht were prepared by Henry J. Gielow, the veteran naval architect of this city, and will be a notable addition to the houseboat fleet. This craft will have the distinction of being one of the first houseboats equipped with heavy oil engines of the Diesel type.

The principal dimensions will be: Length over all 100 feet 9 inches; length on load water line 95 feet 3 inches; beam, moulded, 21 feet; and draught 4 feet 6 inches when fully loaded. The dimensions of this yacht have been determined with a view to securing a thoroughly sea-going vessel, and at the same time obtaining a craft well suited for cruising in the lagoons, streams and inland bays of Florida.

The hull will be constructed of mild steel, the side plating being carried up to the upper deck, with steel deck beams and diagonal strapping, thus securing a thoroughly substantial construction. Her lines will be the combined perfection of sea-going qualities with a minimum draught, and were it not for the rectangular windows, would show all the characteristics of a seagoing motor yacht. These windows, however, add so much to the owner's comforts, both as to light and ventilation, that it was considered best to use them instead of the much smaller, conventional circular air ports.

The deck house will be 44 feet long, with a mean width of 14 feet in the clear, constructed of mahogany panel work. In the forward end will be the dining room 15 feet 6 inches long by 14 feet wide, fitted with buffet and sideboard, china closet, serving tables, etc. The pantry has a floor space of 74 square feet, fitted with dressers, sink, dish racks, china closet; refrigerator and a dumbwaiter to galley below. Aft of dining room, on port side will be a lavatory, and opposite starboard side a cabinet with racks for guns, fishing tackle, ammunition and sporting supplies. Next will be the main saloon or social hall, 18 feet long in the clear and occupying the full width of the deck house, with stairway in the after end leading to staterooms below; among the furnishings will be a desk, book case, piano, divan, etc.

The owner's and guests' quarters will be in the after end of the vessel, and will occupy the entire width for a fore and aft distance of 38 feet. The owner's stateroom will be forward, and have a floor space of 200 square feet, fitted with brass bed, chiffonier, bureau, mirrors and large wardrobe. Forward of this stateroom will be a bath room, connected with the owner's stateroom. Aft of the owner's room will be four more staterooms and two more bathrooms, each stateroom furnished with bed, bureau, and wardrobe, and all bath rooms will have porcelain enameled lavatories, bath tubs, etc., with nickel-plated mountings, open plumbing, and tiled floors and walls.

The machinery space will come next and occupy the full width of the vessel for a distance of 18 feet fore and aft. Next forward comes the galley with a floor space of 130 square feet, fitted with range, dish racks, dressers, lockers, sinks, cold storage, etc.

Forward of this will be the officer's and crew's quarters, all designed on a liberal scale, occupying a floor space of 468 square feet; in fact, the aim in designing this vessel has been to secure fewer large roomy accommodations rather than a larger number of smaller, cramped ones. Liberal accommodations for storage of ice have been provided; but a mechanical refrigerator plant will also be installed. The interior finish will be white pine panel work finished in ivory white, with mahogany trim finished bright.

The propelling machinery will consist of two 120 H. P. six cylinder heavy oil engines of the Diesel type, which gives the vessel a speed of over 12 statute miles per hour. The oil tanks have a capacity of 3,400 gallons, which will give a cruising radius of 2,500 miles at full speed, which is unusually large for a vessel of this type. The propellers are to be of manganese bronze, especially designed for this vessel by Mr. Gielow.

Fresh water tanks are to be provided with ample capacity to last for a cruise of three thousand miles.

Motorship Missourian Launched at Chester, Pa., for American-Hawaiian Line

The 11,000 deadweight ton motor ship, *Missourian*, built for the American-Hawaiian Steamship Company, was successfully launched Wednesday, December 14, 1921, at the Merchant Shipbuilding Corporation's yard, Chester, Pa. This is the second twin screw motor ship, and all American product to be launched on the Delaware River.

The principal dimensions of the *Missourian* are as follows: Length overall, 461 feet; moulded beam, 59 feet 8 inches; moulded depth to shelter deck, 39 feet; cargo capacity, 560,000 cubic feet; contract speed, 11½ knots.

The propelling machinery consists of two Burmeister & Wain six-cylinder, single-acting, four-cycle Diesel engines of the cross-head type. Each engine is rated at 2,250 Diesel indicated horsepower.

Both main and auxiliary Diesel engine sets are nearing completion in the shops of William Cramp & Sons' Ship and Engine Building Company, Philadelphia.

Contract Awarded to George B. Spearin & Co. for New Pier at 44th Street, N. R.

The George B. Spearin & Company, Inc., 90 West Street, New York, with a price of $363,565, was awarded the contract for the construction of a new pier at 44th Street, North River, following the opening of tenders by the Department of Docks, Pier A, North River, New York, on Monday, December 12.

The present pier with its freight shed is to be entirely removed and also the bulkhead shed which extends across the inner end of the pier. The engineer's estimate of the amount of dredging to be done is about 5,400 cubic yards. The pier is to be supported on vertical piles and braced with inclined piles. The superstructure will consist of double rangers over the outer bay and of side and shed rangers, chocking, mooring posts, single bitts, fendering and fender piles, a concrete deck, except wooden decking over the outshore of bay. Four elevator pits are to be constructed and fire walls are to be built beneath the pier across its full width. For the work inshore of the bulkhead line the contract comprises all pier construction including retaining walls, pile and timber work, sheet piling, concrete foundations, concrete deck, etc. It is estimated that about 3,000 cubic yards of riprap will be used to secure greater stability around the piles.

The time allowed for completion is 275 days.

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$43,000,000 Recommended For Government Port and River Work During Fiscal Year 1922-23

Substantial Sums Requested by Chief of Army Engineers for Development of Principal Harbors on Atlantic and Pacific Seaboards

MAJOR GENERAL BEACH, Chief of Army Engineers, in his annual report to the Secretary of War, Washington, D. C., recommends a total expenditure of approximately $43,000,000 for river and harbor improvements during the fiscal year 1922-23, exclusive of the proposed $7,500,000 project for Muscle Shoals, Ala. Among the principal harbor projects are the following:

New York, $2,900,000 including $2,200,000 for the East River and $350,000 for the Hudson River Channel; Philadelphia to the sea, $3,660,000 including $500,000 for Philadelphia Harbor and $1,500,000 for Liston Range; Savannah, Ga., $1,025,000; Norfolk, $500,000; Los Angeles, $300,000; Humbold, Cal., $400,000; and Grays Harbor and Bar Entrance, Wash., $660,000.

Principal river projects: Mississippi from the mouth of the Ohio to the mouth of the Missouri, $1,000,000; from the mouth of the Missouri to Minneapolis, $2,000,000; Southwest Pass, $1,136,000, and South Pass Channel, $250,000; Ohio for locks and dams, $5,000,000 and for general open channel work, $534,000; Allegheny Locks and dams, $900,000, and open channel work, $5,000; Detroit, $1,100,000; Illinois below Copreas Creek, $440,000; Columbia and lower Willamette below Vancouver and Portland, Ore., $850,000; Missouri, $145,000 including $25,000 from Kansas City to Sioux City and $20,000 from Sioux City to Fort Benton, Montana, and St. Marys River, Mich., $557,000.

Remarkable Feat Accomplished In Salvaging and Docking the 12,000 Ton Standard Oil Tanker F. D. Asche

ONE of the most remarkable salvage operations on record was performed when the *F. D. Asche*, a Standard Oil tanker, arrived in New York recently, after being towed all the way from the Bahamas with practically no bottom in her. The *Asche*, in command of Captain L. S. McKenzie, was caught in the cyclone that devastated Tampa, swept out of her course and piled up on Stranger Key reef. In the next twenty-four hours the *Asche* was carried one mile over the reefs where she remained fast.

The wrecking steamers *I. J. Merritt* and *Willard*, of the Merritt-Chapman Wrecking Company, were sent to the assistance of the *Asche*. It was found by the divers that the hull of the *Asche*, with the exception of the bottom, had remained intact and that the oil carrier was susceptible therefore to being raised by means of compressed air tanks.

After being raised and still kept afloat by the emergency compressed-air tanks, the two wrecking steamers took the *Asche* in tow and brought her safely to New York, where she was docked in the graving dock of the Robins Dry Dock and Repair Company of the Todd Shipyards Corporation. The docking of this vessel with only the information furnished by divers as to where and how high the supporting blocks should be placed was also an engineering feat.

The accompanying photograph was taken after the *Asche* was dry docked. The bottom from the bow to the stern is one continuous wave with an amplitude of four to eight feet. Undoubtedly the Isherwood system of longitudinal framing permitted the bottom to take a wave formation without breaking, as transverse frames would have presented too many hard spots. At any rate, this system of framing has localized the repairs to the portion damaged. That is, an entire new bottom to a point between eight and ten feet above the keel will have to be fitted, but the sides above this point are in good condition.

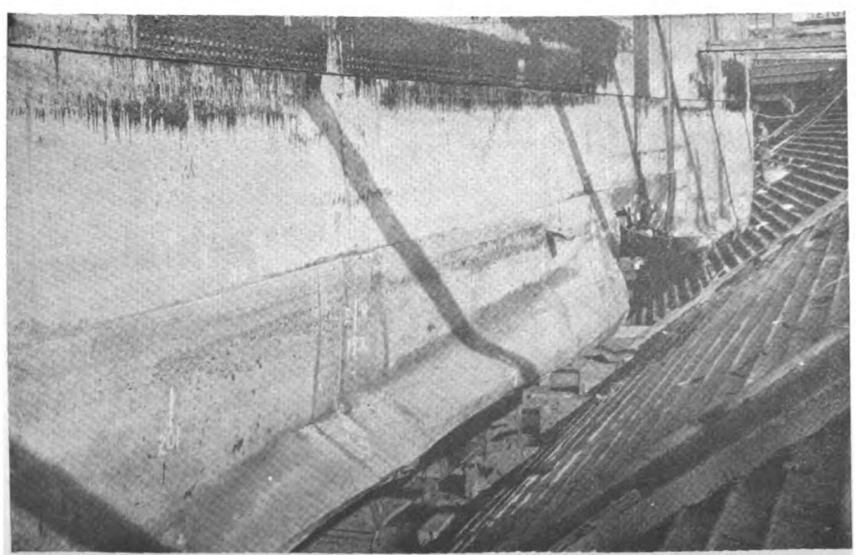

Photo by Todd Shipyards Corporation

The F. D. Asche in Dock, Showing Crumpled and Torn Plates

CONVERSION COMPLETED

Aircraft Carrier Wright Turned Over to Navy Department

The Todd Shipyards Corporation has turned over to the United States Navy the U. S. S. *Wright*, which has been converted into a balloon and seaplane mother ship The vessel is named in memory of Wilbur Wright.

The conversion of this vessel, originally built for the transport service, was carried out at the Tietjen & Lang plant in Hoboken, N. J. It included additions, changes and alterations that would provide for the stowage of six kite balloons for the inflation and housing of kite balloons aft in a balloon well, for the necessary hydrogen generating plant for balloon inflation, for hydrogen stowage and for efficient repair plants for balloons and seaplanes.

The vessel has been arranged for flying operations of kite balloons and as a tender for seaplanes, carrying spare wings and other spare parts. A pigeon coop, aerological laboratory and a complete photographic laboratory have been provided.

A hydrogen generator of large capacity, constructed to use salt water for cooling, a number of hydrogen compressors, a number of hydrogen flasks and an air blower for the kite balloons and two balloon winches will be installed for use in the flying operations and the inflation of balloons.

The repair facilities consist of wire assembly shop, tool issuing room, blacksmith, foundry, sheet metal and coppersmith shop; carpenter and pattern shop, machine shop and motor erecting shop, electrical work shop, fabric and dope shop. Two balloon winches are being fitted for use in flying operations of balloons. A large space forward is provided for wing section stowage, and a large hatch in the weather deck for the purpose of getting the wing sections below. Space will also be available for the stowage of spare parts for kite balloons and seaplanes.

The battery will include four 5-inch 51 caliber guns, two forward and two aft.

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Marine Construction News of the Month

Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPS AND SHIPBUILDING

Reconditioning Job.—The firm of Theodore Crane & Sons, Brooklyn, N. Y., with a price of $44,875 and twenty-five days, were low bidders for the reconditioning of the United Fruit Company steamship Tanamo, bids for which were opened December 7. The highest bid for the job, submitted by the Atlantic Basin Company, amounted to $83,486 and sixty days.

To Convert Steamer, Hoboken, N. J.—The W. & A. Fletcher Company has been awarded the contract for reconditioning the steamship Lake Fackler, operated by the Clyde Line, bids for which were opened by the Shipping Board on December 5. The vessel is to be converted into a fruit carrier and the specifications called for the providing of eight cargo ports, sheathing of the 'tween decks with planking, the putting up of banana bins, the installation of sixteen ventilators and various other detail work. The Fletcher price was $10,327.

Dredge to Be Overhauled, Shooters Island, N. Y.—The Standard Shipbuilding Corporation, with a bid of $28,000, was awarded the contract for the extensive overhauling of the Municipal dredge Grabit, of the Department of Docks, Pier A, North River, New York.

Large Repair Job, Hoboken, N. J.—The United Fruit Company's steamship Heredia is at the yards of the W. & A. Fletcher Company for extensive repairs, which will probably cost close to $100,000.

Steamer Conversion.—The Bethlehem Shipbuilding Corporation, Ltd., was low bidder for the job of reconditioning the Munson Line steamship Walter D. Munson, bids for which were opened at the Munson Line office in New York on December 6. The Bethlehem Company's bids were (a) $288,500 and 120 days, and (b) $237,680 and 90 days. The ship may be converted into a combination passenger and freighter with accommodations for about 175 passengers. Proposition "A" provided for the building of a shelter deck over the well deck and proposition "B" called for the building up of the superstructure in order to meet the requirements of the specifications.

Reconditioning Contract, New York.—Bids for reconditioning the transport Northern Pacific for passenger service were opened at 3 p. m., on December 15, at the office of the Robert Dollar Steamship Company, 11 Moore street, New York City. It is understood that the award of the contract rests principally between the Sun Shipbuilding Company and the W. & A. Fletcher Company. The prices submitted were as follows: Sun Shipbuilding Co., $335,460, 110 days; Newport News Shipbuilding Co., $401,800, 90 days; Robins Dry Dock & Repair Co., $421,000, 95 days; W. & A. Fletcher Co., $424,710, 85 days; Morse Dry Dock & Repair Co., $550,000, 120 days; Wm. Cramp & Sons Ship and Eng. Bld. Co., $550,000, 240 days; Bethlehem Shipbuilding Corp., $698,000, 140 days.

Steamer Repairs, Brooklyn, N. Y.—The Tebo Yacht Basin, of the Todd Shipyards Corporation, was awarded the contract for repairs to the steamship Bessie Dollar at the opening of bids on Monday, December 12. The price was $1,495.

Barge Wanted, Brooklyn, N. Y.—The United Machine Works, Thomas Jefferson Building, is in the market for the purchase of a barge operated by steam, having a stern paddle wheel, similar to steamers used on the Mississippi river.

Vessel Damaged by Fire, Boston, Mass.—The British steamship Amasis, which arrived at Boston on December 3 from Alexandria with 15,000 bales of cotton, was afire at her pier. Damage sustained is estimated at $45,000.

May Build Schooner, Baltimore, Md.—It is reported that a Cuban representative of business interests in that island was in the city of Baltimore interviewing shipbuilding companies as to the cost of a prospective schooner to be built of steel.

Derrick Boat, Pittsburgh, Pa.—The United States Engineer, Custom House, Nashville, Tenn., has let a contract to the Dravo Contracting Company, Diamond Bank Building, for the construction of a derrick boat at a price of $11,785.

Want Wooden Hulls for Lighters, Portland, Ore.—The Shipping Board is considering the bid of the Port of Portland for four wooden hulls moored in that port. If the bid is accepted, the city proposes to use the hulls for lighters.

To Acquire Steamers, San Pedro, Cal.—It is reported that a statement by Earl M. Leaf, vice-president of the Los Angeles Steamship Company, is to the effect that his company may buy five steamers from the United States Shipping Board which they would have converted into passenger and cargo steamers for the Oriental trade.

Extensive Repairs, Chicago, Ill.—After having been tied up at Philadelphia for about five years, the former Clyde Line steamer George W. Clyde has left for Chicago with a cargo. The vessel will be extensively reconditioned and will be added to the Lake Michigan fleet of the Chicago Steamship Company.

Propeller Contract Award, New York.—The Ferguson-Herbert Corporation, 95 Liberty street, builders of semi-steel, steel and bronze propellers, has been awarded a continuous contract for the supply of propellers for the tugs and Sound steamers of the New England Steamship Company. The Ferguson-Herbert Corporation has similar contracts with a number of railroad, ferry and towing lines in New York harbor.

Boat Contract Awarded, Oakland, Cal.—It is announced from San Francisco that the Pacific Boat Company has been awarded the contract for a new dispatch and towing boat for use about San Francisco Bay, the price being $10,759.

Mechanical Burners, New York.—The Todd Shipyards Corporation has received an order for thirty Todd mechanical burners made by the White Fuel Oil Engineering Company for installation on the Canadian-Pacific Ocean service steamship Montclare, which is now building on the Clyde Bank. This means that the ship will be fully equipped with an American burner system.

To Recondition Steamer, New York.—It is reported that the steamship New York, which was recently sold at a marshal's sale, is to be reconditioned immediately and placed in the Reval-Danzig service as a sister ship to the steamer Gdansk. The vessel will have the same operating and passenger agents as the Gdansk.

Steamship Repairs, Sparrows Point, Md.—The United States Shipping Board has awarded the contract for docking and repairing the steamer Eastern Temple to the Bethlehem Shipbuilding Corporation on a bid of $4,915, and the contract for repairs to the West Lashaway to the H. E. Crook Company at a price of $1,543.

Repair Contract Awards, Hoboken, N. J.—The contracts for repairs to the Tide Water Oil Company steamer Robert H. Hopkins and the Hudson Day Line steamer Hendrick Hudson and the Army transport Wheaton have been awarded to the W. & A. Fletcher Company. The total amount involved will probably be close to $16,500.

Vessel to Be Overhauled, New York.—It is reported that the passenger and freight steamer Argentina, which has just been purchased by the Luckenbach Steamship Company at a price of less than $25 per ton, will be overhauled in New York at a cost of approximately $50,000. She is a vessel of 10,000 tons, and her present passenger accommodations will be taken out in order to fit the ship for the company's intercoastal service.

Service Boat, San Pedro, Cal.—Work is being pushed at the plant of the Los Angeles Shipbuilding & Dry Dock Company on the construction of a combination oil, water, and service boat which, when completed, will be operated by the company to serve shipping in Los Angeles harbor. The boat will be of steel, 88 feet long with 484 tons of oil tank capacity. She is to be equipped also with water tanks and can be used for the transportation of deck loads of lumber or varied cargo.

Reconditioning Contract Award, Seattle, Wash.—The contract for reconditioning the steel steamship Starr, of the San Juan Fishing & Packing Company, has been awarded to the Seattle Shipbuilding & Dry Dock Company, the job to cost about $15,000.

Schooner Repairs, San Francisco, Cal.—The Union plant of the Bethlehem Shipbuilding Corporation was low bidder at a price of $20,996, for repairs to the steam schooner Thomas Crowley, which was recently taken off the rocks near Point Concepcion. Other tenders submitted were Hanlon Dry Dock, $29,160; Moore Shipbuilding, $43,465; Barnes & Tibbitts, $44,098; United Engineering Company, $48,311, and Benjamin Dallerup & Son, $52,800.

To Build Icebreaker, Montreal, Canada.—The contract for the construction of the Canadian Government icebreaker to be used on the St. Lawrence River has been awarded to Canadian Vickers, Ltd., this company being the lowest bidder at a price of $1,580,000. Other bids included the Wallace Shipbuilding Company, Vancouver, $1,872,000; J. Coughlan & Sons, Vancouver, $1,800,000; and the Halifax Shipyards, Halifax, $1,750,000.

May Purchase Freighters, Vancouver, B. C.—It is reported that the Canadian Robert Dollar Company will purchase two large freighters early in 1922, to be added to their present fleet. One of the vessels will be put on the round-the-world service maintained by the Dollar Company, and the other on the Vancouver-Orient Line, thus permitting a thirty-day Oriental schedule.

Lightship Launched, Morris Heights, N. Y.—The steam lightship No. 105 being constructed at the plant of the Consolidated Shipbuilding Corporation for the Baltimore lighthouse district has just been launched, and as soon as ready will be brought to Baltimore to be fitted for service. The new vessel, which is an oil burner, is intended to replace the lightship sunk off Diamond Shoals by a German submarine during the war.

Three New Passenger Liners to Be Built, San Francisco, Cal.—According to latest reports bids have been asked for the construction of three new passenger liners for the coastwise service of the San Francisco & Portland Steamship Company. The company has only one vessel operating between San Francisco and Portland at present and is anxious to put in commission more vessels in order to help out the Rose City, and to replace the steamer Bear, which was lost, and the Beaver, which was taken over by the Government during the war. It is said that the new steamers will be similar to the Bear and Beaver, but will be along more modern lines, to have greater speed and more beam. Passenger accommodations will embody the most modern facilities. The ships will also have a large cargo carrying capacity.

Shipbuilding Activities at Port Arthur, Ont.—It is reported that the plant of the Port Arthur Shipbuilding Company will remain open all winter, giving steady employment to a large number of men. They are doing a great deal of dry docking and extensive repairing on lake steamers and tugs. The steamer Huronton, which is an American boat recently purchased by the Matthews Steamship Company, of Toronto, is to undergo extensive repairs, and will probably remain at the yard all winter. In addition to the general repairs a complete set of new boilers will be installed, the boilers to be de-

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signed, built and erected at the Port Arthur Shipbuilding Company's plant. The company has on hand orders for two large boilers for the western market, as well as for low pressure heaters of varying sizes, which will be built during the winter. The company will also build on speculation about twenty low pressure boilers of various sizes, which will be placed on the market. They are also said to be negotiating for the contract to build a big bulk lake freighter in the near future.

Dumper and Scow Repair Bids, Brooklyn, N. Y.—At the opening of bids by the Department of Street Cleaning, Ira Bushey & Son, Brooklyn, N. Y., was low bidder for repairs to dumper No. 8 and the National Dry Dock Company was low bidder for repairs to scow No. 12.

Boat Surveys, New York.—It was learned today that the Department of Plant and Structures is conducting a survey of the nine boats of the Union Ferries, preparatory to taking over these lines, and the Board of Estimate has authorized the institution of condemnation proceedings for the Brooklyn terminals. Plans and specifications for the three electric drive ferries for service to Staten Island are almost completed.

Coastwise Vessel.—Plans and specifications for an 18-knot coastwise, Diesel engined passenger ship have been prepared by Robert W. Bruce, naval architect, Washington, D. C. Mr. Bruce stated that the identity of the owners is confidential at this time. The vessel will carry 150 first class and 50 steerage passengers. The propelling machinery will have 6,000 horsepower.

Alteration Contract Placed, New York.—The New York Harbor Dry Dock Company, with a price of $41,361, was awarded the contract for the installation of a steam heating system in the lower 'tween decks and the putting in of fruit carrying equipment in the Shipping Board steamers, Lake Fillmore, Pulwico, Vinton County and Lake Faristol at the opening of tenders by the Shipping Board at 45 Broadway, on December 12.

Derricks, Nashville, Tenn.—The District Engineer, United States Engineer Office, Post Office Box 900, Nashville, Tenn., will receive bids until 11 a. m., January 16, 1922, for the construction of three steel derricks. The derricks are to be of the stiff leg type and all parts are to be designed to safely withstand the maximum stresses resulting from the following conditions: dredging with an 8,500 pound 1½ cubic yard orange peel bucket with the long boom at 10 degrees with the horizontal or 20-ton live load on short boom at 35 degrees with horizontal and straight-ahead. Engines with a rating of about 12,000 pounds pull are to be used on the boats. The vertical height from deck to the top of A-frame is to be not more than 46 feet, the bull wheel shall be of structural steel or structural steel and steel castings and shall be 16 feet in diameter. All three outfits are to be delivered f. o. b. Fox Bluff, Tenn., a station on the Tennessee Central Railroad about 40 miles from Nashville, Tenn. Both of the 74 by 34 foot derrick boat hulls will be in place to receive the derrick equipment by the time the award is made, but the 76 by 34 foot hull just contracted for will not be delivered until May, 1922.

Boiler Contract Bids, Memphis, Tenn.—Bids for furnishing and delivering two watertube boilers for the United States dredge Beta and three watertube boilers for United States dredge Henry Flad were opened at 3:30 p. m., November 16, at the office of Colonel L. A. Rand, Corps of Engineers, Mississippi River dredging district. The Charles Ward Engineering Works, Charleston, W. Va., with a price of $18,750, was recommended for awarding of the contract for three boilers for the Henry Flad and the Babcock & Wilcox Company, Cincinnati, Ohio, and New York, with a price of $14,353, was recommended for awarding of the contract for two boilers for the Beta.

Packet Boats, New York City.—Plans and specifications for five new packets to ply between New York and Buffalo are under way by R. R. Livingston, Marine Engineer, of 2 Rector street, according to official information obtained by Marine Engineering and Shipping Age. The boats will be equipped with Diesel electric drive and it is believed the total cost will be close to half a million dollars. Preliminary figures place the length of the packets at about 160 feet with a carrying capacity of 500 tons each. There will be two Diesel engines, driving generators, and two motors, driving twin propellers. The power plant of each boat will develop about 260 horsepower. It is understood that the five boats are to be completed by May, 1922.

CONSTRUCTION FOR NAVY

Vessels under construction for United States Navy and their degree of completion as reported November 30, 1921, by the Bureau of Construction and Repair, Washington, D. C., are as follows:

Type Number and Name	Contractor	% of Completion Dec. 1, 1921 Total
BATTLESHIPS (BB)		
45 Colorado	New York S. B. Corpn.	84.9
47 Washington	New York S. B. Corpn.	69.8
48 West Virginia	Newport News S. B. & D. D. Co.	65.7
49 South Dakota	New York Navy Yard	36.5
50 Indiana	New York Navy Yard	33.9
51 Montana	Mare Island Navy Yard	27.6
52 North Carolina	Norfolk Navy Yard	36.7
53 Iowa	Newport News S. B. & D. D. Co.	30.7
54 Massachusetts	Beth. S. B. Corpn. (Fore River)	11.0
BATTLE CRUISERS (CC)		
1 Lexington	Beth. S. B. Corpn. (Fore River)	28.8
2 Constellation	Newport News S. B. & D. D. Co.	17.1
3 Saratoga	New York S. B. Corpn.	31.0
4 Ranger	Newport News S. B. & D. D. Co.	3.5
5 Constitution	Philadelphia Navy Yard	12.3
6 United States	Philadelphia Navy Yard	11.5
SCOUT CRUISERS (LIGHT CRUISERS) (CL)		
4 Omaha	Todd D. D. & Const. Corpn.	98.4
5 Milwaukee (a)	Todd D. D. & Const. Corpn.	93.6
6 Cincinnati	Todd D. D. & Const. Corpn.	87.4
7 Raleigh	Beth. S. B. Corpn. (Fore River)	63.7
8 Detroit	Beth. S. B. Corpn. (Fore River)	74.4
9 Richmond	Wm. Cramp & Sons Co.	81.
10 Concord	Wm. Cramp & Sons Co.	74.
11 Trenton	Wm. Cramp & Sons Co.	53.
12 Marblehead	Wm. Cramp & Sons Co.	47.
13 Memphis	Wm. Cramp & Sons Co.	40.

(a) To correct error in October report.

AUXILIARIES		
Repair Ship No. 1, Medusa (AR1)	Puget Sound Navy Yard	72.5
Dest. Tender No. 3, Dobbin (AD3)	Philadelphia Navy Yard	66.6
Dest. Tender No. 4, Whitney (AD4)	Boston Navy Yard	41.3
Sub. Tender No. 3, Holland (AS3)	Puget Sound Navy Yard	21.5
Aircraft Tender, Wright (AZ1)	Tietjen & Lang	99.3
PATROL VESSELS		
Gunboat No. 22, Tulsa (PG22)	Charleston Navy Yard	71.2
Authorized but not under construction or contract: (1) Transport No. 2.		
DESTROYERS		
338 Wasmuth (b)	Mare Island Navy Yard	99.9
339 Trever	Mare Island Navy Yard	98.0
340 Perry	Mare Island Navy Yard	82.7
341 Decatur	Mare Island Navy Yard	79.5
Destroyers authorized but not under construction or contract: (12) Nos. 348 to 359 inclusive.		

(b) Ready to be commissioned.

SUBMARINES		
115 S-10	Portsmouth, N. H., Navy Yard	94.8
116 S-11	Portsmouth, N. H., Navy Yard	92.3
117 S-12	Portsmouth, N. H., Navy Yard	92.1
118 S-13	Portsmouth, N. H., Navy Yard	90.3
123 S-18	Electric Boat Co. (Quincy)	97.0
124 S-19	Electric Boat Co. (Quincy)	96.5
125 S-20	Electric Boat Co. (Quincy)	98.5
126 S-21	Electric Boat Co. (Quincy)	94.9
127 S-22	Electric Boat Co. (Quincy)	95.8
128 S-23	Electric Boat Co. (Quincy)	94.0
129 S-24	Electric Boat Co. (Quincy)	93.0
130 S-25	Electric Boat Co. (Quincy)	93.5
131 S-26	Electric Boat Co. (Quincy)	92.4
132 S-27	Electric Boat Co. (Quincy)	91.0
133 S-28	Electric Boat Co. (Quincy)	91.6
134 S-29	Electric Boat Co. (Quincy)	90.5
136 S-31	Electric Boat Co. (San Fran.)	97.7
137 S-32	Electric Boat Co. (San Fran.)	96.0
138 S-33	Electric Boat Co. (San Fran.)	99.2
139 S-34	Electric Boat Co. (San Fran.)	95.5
140 S-35	Electric Boat Co. (San Fran.)	93.3
141 S-36	Electric Boat Co. (San Fran.)	90.7
142 S-37	Electric Boat Co. (San Fran.)	89.2
143 S-38	Electric Boat Co. (San Fran.)	83.7
144 S-39	Electric Boat Co. (San Fran.)	81.0
145 S-40	Electric Boat Co. (San Fran.)	80.0
146 S-41	Electric Boat Co. (San Fran.)	81.5
153 S-42	Electric Boat Co. (Quincy)	78.1
154 S-43	Electric Boat Co. (Quincy)	78.8
155 S-44	Electric Boat Co. (Quincy)	76.7
156 S-45	Electric Boat Co. (Quincy)	77.3
157 S-46	Electric Boat Co. (Quincy)	75.9
158 S-47	Electric Boat Co. (Quincy)	75.1
159 S-48	Lake T. B. Co. (Bridgeport)	98.3
160 S-49	Lake T. B. Co. (Bridgeport)	97.0
161 S-50	Lake T. B. Co. (Bridgeport)	92.9
162 S-51	Lake T. B. Co. (Bridgeport)	91.0
FLEET SUBMARINES		
60 T-2 (SF 2)	Electric Boat Co. (Quincy)	99.3
163 V-1 (SF 4)	Portsmouth, N. H., Navy Yard	9.7
164 V-2 (SF 5)	Portsmouth, N. H., Navy Yard	8.2
165 V-3 (SF 6)	Portsmouth, N. H., Navy Yard	8.0

Note: Submarines authorized but not under construction or contract:
Fleet Submarines (6) Nos. 166 to 171.
Nefl Submarine (1) No. 108.

Returns for Construction Job, Pittsburgh, Pa.—Abstract of proposals for furnishing and delivering six steel dump scows, received in response to advertisement and specifications dated October 24, 1921, and opened at U. S. Engineer Office, Pittsburgh, November 23, 1921:

Nashville Bridge Co., Nashville, Tenn.	$104,340
Charles Ward Engineering Works, Charleston, W. Va.	89,400
Dravo Contracting Co., Pittsburgh, Pa.	70,500
Green Bay Dry Dock Co., Green Bay, Wis.	60,000
John Eichleay, Jr., Co., Pittsburgh, Pa.	100,200
Riter-Conley Co., Pittsburgh, Pa.	83,610
American Bridge Co., Pittsburgh, Pa.	70,200
Midland Barge Co., Midland, Pa.	80,400

SHIPYARDS AND DRYDOCKS

Buys Shipyard, Portland, Ore.—It is reported that the plant of the Peninsula Shipbuilding Company at the foot of McKenna avenue has been purchased by G. F. Matthews, who will operate the yard for the construction of coastwise vessels.

Floating Dry Dock, Green Bay, Wis.—Plans and specifications for the construction of a floating dry dock for the Green Bay Dry Dock Company have been completed by E. J. Morrison, consulting engineer, 53 West Jackson Boulevard, Chicago, Ill. The dock will cost about $300,000.

Plant Addition, Jersey City, N. J.—Plans have been filed by the Vulcan Iron Works, Hudson street, for the construction of a one-story addition to its plant to cost $17,000. Equipment to be installed in this new building is not included in the sum above mentioned.

New Shipbuilding Firm, Quebec, Can.—A new shipbuilding company has recently been organized with a capital of $500,000. The company will establish a yard on the St. Charles River and will employ about 500 men. G. LeClare, O. Lemay, P. Lepage, A. Milville and F. Choquette, all of Quebec, are interested.

Shipyard Sold, New Orleans, La.—It is announced that the buildings of the Foundation Company's shipyard, which were erected and equipped by the French Government in 1917 at a cost of more than $2,000,000, have been sold at auction for $35,100 to the Oliver H. Van Horn Machinery Company, of New Orleans.

New Company to Operate Yard, Boothbay, Maine.—The Reed-Cook Construction Company was recently organized and has acquired the yard of the East Coast Ship Company for operation. Irving W. Reed, of Boothbay, and Fred M. Cook, naval architect, formerly associated with the Bath Iron Works, are interested in the new company.

May Build Dry Dock, Jacksonville, Fla.—It is reported that the Merrill-Stevens Dry Dock and Repair Company contemplates the construction of a 10,000 ton dry dock, and have had plans under consideration at any time the return of prosperity to shipping lines seems permanent. With the deepening of the channel, larger ships will be coming into Jacksonville and a dock of this size will be necessary.

Shipyard Equipment Sold, Aberdeen, Wash.—The United States Shipping Board has offered for sale all equipment and supplies of the Grant Smith Porter shipyard, comprising supplies having an original value of $300,000 and plant equipment including engines, cables, motors and boiler, as well as miscellaneous machinery, valued at $200,000. According to Mr. W. F. White, of the Tacoma office of the Shipping Board, the entire holdings will be sold piece by piece, and no sale shall be made for less than $100. Disposal of this yard will mark the closing of one of the wartime yards started by the Board in 1917.

To Build Pontoon for Dry Dock, Seattle, Wash.—It is announced by C. W. Wiley, president of the Todd Dry Docks, Inc., that work would commence at once on the fifth pontoon for the company's large floating dry dock, the construction of which is estimated to cost about $175,000. The fifth unit will also be constructed at Port Blakely as were the other four. This additional pontoon will give the dock a total length of 520 feet, thus insuring the largest ships coming to Seattle, of placement in dry dock without possibility of dangerous overhang.

Proposed Shipbuilding and Repair Plant, Jersey City, N. J.—The Weehawken Dry Dock Company, through Commodor[illegible]

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plans to the city commissioners of Jersey City, N. J., for the construction of a huge shipbuilding and ship repairing plant on a site including part of Jersey City's south cove adjoining the Morris Canal and lying east of Henderson street. The plant would be built immediately provided the city grants the lease asked for, which is for twenty-five years, with an option of renewal for a similar period at the expiration of the first lease. The company proposes to pay a rental to the city of 60 percent of the rate now being paid, and to expend $300,000 for the development of the tract, dredging it, and erecting the shipyard. This project would provide employment for at least 2,000 men.

PORT IMPROVEMENTS

Dock Improvements, Sarnia, Ont.—Extensive improvements to their docks are contemplated by the Port Huron-Sarnia Ferry Company of 304 Quay Street, Port Huron, Mich. Henry M. Morran is president and general manager of the company.

Steamship Terminal Facilities, Charleston, S. C.—The Clyde Steamship Company is reported as contemplating the enlargement of their terminal facilities. Edward A. Kelly is general manager.

Piers, St. Petersburg, Fla.—The city plans to expend at least $200,000 for the restoration of the temporary pier and contemplates building a pier to cost from $500,000 to $1,000,000. Further information may be obtained by addressing the mayor.

To Rebuild Piers, Weehawken, N. J.—Plans are under way for rebuilding the Erie Railroad piers along the Hudson River which were recently destroyed by fire. The work is estimated to cost about $1,500,000. R. C. Falconer, 50 Church Street, New York, is engineer for the company.

Will Replace Dock, New Orleans, La.—The New Orleans Dock Board is completing plans for the construction of a banana loading wharf for the Cuyamel Fruit Company to replace the docks which were recently destroyed by fire. H. M. Gallagher is engineer in charge for the board.

River Terminals, Vicksburg, Miss.—The Federal Barge Line, of which J. T. Atkinson is general agent, Memphis, Tenn., has purchased a site for river terminals. The sum of $400,000 has been appropriated for this project.

Harbor Improvements, San Pedro, Cal.—A comprehensive program for harbor improvements was outlined recently at a meeting of the harbor commission with representatives of the local commercial organization.

Dredging, Lake Worth, Fla.—The Lake Worth Inlet Commissioners have let a contract to the Anderson Dredging Company for the excavation of 20,000 cubic yards of rock and dirt from the Lake Worth Inlet channel, the work to cost about $100,000.

Terminal Facilities, Corpus Christi, Tex.—The city will vote February 23, 1922, on $1,000,000 bonds for the purpose of establishing a navigation district and terminal facilities in connection with a deep water port. T. M. Lawrence is county commissioner.

Pier, Wildwood, N. J.—The Serpentine Railway Company, 2016 West Lippincott Street, Philadelphia, plans the construction of a 200 by 400-foot concrete and timber amusement pier, to cost $250,000. S. G. Matthews, 2016 Lippincott Street, Philadelphia, is engineer.

Wharves, Pensacola, Fla.—The City Commission contemplates the improvement and extension of terminal facilities, involving the expenditure of about $200,000. They propose to acquire the Palafox wharves and adjacent property.

Canal, Georgetown, S. C.—The Rivers and Harbors Committee of the Chamber of Commerce of Georgetown, S. C., W. D. Morgan, chairman, is reported as contemplating the construction of a canal between Georgetown and McClellanville, as part of the inland waterways system extending from Maine to Florida.

Dock Equipment, Tacoma, Wash.—G. W. Osgood, port engineer of the Port of Tacoma, 612 Tacoma Building, will receive bids next February for four 3-5 ton steel cranes of the loft and boom type, one 2-ton electric monorail hoist, 220 v. d. c., about 4,000 feet of monorail trackage, as well as miscellaneous conveying equipment, etc.

Dredging, Wilmington, N. C.—Major Milo P. Fox, District Engineer, has been granted an additional $50,000 allotment for dredging and other harbor improvement work in the Cape Fear River between Wilmington and the sea. The sum of $170,000 is now available for the work. Major General L. H. Beach is chief engineer.

Dock, Tarpon Springs, Fla.—The city is considering the construction of a dock to cost $30,000 for the sponge fleet.

Pier, Gulfport, Fla.—The city will rebuild a 500-foot pier with a "T" head. For further information address the mayor.

Dock and Boathouse, Osceola, Mo.—The Osage Resort Company plans a dock and boathouse on the Osage River, to cost $50,000. G. E. Linn is manager.

Flour Depot, Mobile, Ala.—The Dixie-Portland Flour Company, Memphis, Tenn., contemplates the building of a flour depot on the river front at Mobile.

Concrete Wharf, Houston, Texas.—T. Tellepsen, Prince Building, has been awarded a contract for the construction of a concrete wharf on the Houston ship channel at a price of $180,140.

Municipal Dock, Etc., Bradentown, Fla.—The city Board of Trade contemplates a bond issue and has approved plans for the construction of a municipal dock and waterfront park.

Pier Extension, Bay St. Louis, Miss.—The Hancock County Supervisors have let a contract for building a 150-foot extension to the Bay St. Louis automobile ferry pier.

Docks, Warehouses, Etc., Miami, Fla.—The city has voted $200,000 bonds for two docks, two warehouses and railroad tracks, etc., as well as 100,000 cubic yards of excavation. C. W. Murray is city engineer.

Dredging, St. Petersburg, Fla.—The city plans to dredge Bayboro Basin, involving 100,000 cubic yards of sand and rock excavation, costing $50,000. R. E. Ludwig is engineer.

GOVERNMENT WORK

Dredging, Norfolk, Va.—Specification 4553. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans dredging in Norfolk harbor.

Seawall, Puget Sound, Wash.—Specification 4562. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans the construction of a seawall.

Fire Protection System, Charleston, S. C.—Specification 4558. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans a fire protection system.

Dredging, Newport, R. I.—Specification 4552. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans dredging at Goat Island.

Piping, Charleston, S. C.—Specification 4557. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans the installation of piping for an air compressor.

Quarters, Duluth, Minn.—Specification 4549. The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning quarters at the radio station.

Distilling Plant, Key West, Fla.—Specification 4546. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans a distilling plant.

Wharf Repair, Parry Sound, Ont.—The Dominion Government, Ottawa, Canada, has awarded a contract to Weddell & Saunders, Trenton, for repairing the wharf at a price of $28,866.

Turbo Alternator, Pearl Harbor, T. H.—Specification 4548. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to install a turbo alternator.

Dredging, San Francisco, Cal.—The United States Engineer Office has let the contract for dredging in Richmond Harbor, Cal., to the United Dredging Company of Oakland, Cal., at a price of $143,807.

Substation, Etc., Boston, Mass.—Specification 4550. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans a substation and distributing system at the naval dry dock.

Air Compressor, New York.—Specification 4555. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to install a reciprocating air compressor.

Pier Extension, Puget Sound, Wash.—Specification 4556. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to rebuild and extend Pier 5.

Electric System, Etc., San Diego, Cal.—Specification 4559. The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans the installation of gas, water, sewer and underground electric systems, to cost about $100,000.

FOREIGN ACTIVITIES

Motorships, Middlesbrough, Eng.—Two motor cargo vessels will soon be constructed at the yard of the Furness Shipbuilding Company for the account of Furness, Withy & Company. The engines for these vessels are to be of the Tosi type, built by Richardson-Westgarth & Company. The twin screw installations in these ships will develop 2,500 brake horsepower.

Launch First Vessel, Scotstoun, Scotland.—The Blythswood Shipbuilding Company, Ltd., launched its first vessel for Chilean owners on December 15. The vessel is constructed on the Montgomerie-MacMillan system of double bottom construction.

Extensions to Harbor of India.—It is reported that proposals for harbor extensions at Bombay, Calcutta, Jurrachee and Rangoon are under consideration and will soon be taken in hand.

New Steamship Company, Kovno, Russia.—According to a report from Kovno, a new Lithuanian steamship company has been organized, supported by American capital. The company, which will trade mainly in the Baltic, is said to have a capital of $300,000 and to have purchased six steamers in England.

More Motorships, Sweden.—Another Swedish steamship company is reported to have sold four of its steamers, comprising a total of 40,000 tons deadweight, with the intention of using motor vessels in their stead. The company proposes to build sixteen more motor ships.

New Steamship Line, Oscarsham, Sweden.—A new steamship company has been formed to be known as the Rederiaktiebolaget Vallde, with a minimum share capital of 100,000 crowns and a maximum of 300,000 crowns. It is announced that the Rederaktiebolaget Aeolus has increased its share capital to 750,000 crowns.

Wireless Station, Norway.—According to reports received by the Department of Commerce, Washington, D. C., the sum of 10,000 crowns has been voted for the establishment of a wireless station at Tramso, Northern Norway. The total cost will be 1,250,000 crowns.

New Norway Dock.—Improvements are contemplated in Northern Norway according to reports received by the Department of Commerce, Washington, D. C., the developments in Trondhjem which are already under way being the most important. The new dock for pumping pyrites into ships will cost over 2,000,000 crowns and is planned for an anticipated annual export of 120,000 tons. A new steel bridge will soon be constructed to cost about 3,000,000 crowns. Harbor work is also planned in Finmarken.

Shipbuilding, Lubeck, Germany.—The 5,400 cargo steamer Freifeld has been launched from the yard of the Schiffs & Dockbauwerft Feldner, A.G., Siems, near Lubeck, for the account of the Continentale Reederei A.G., Hamburg, to be placed in their transatlantic services. A sister ship, now under construction for the same company, will be launched in a few weeks, at which time the keel for the first of six vessels of similar tonnage will be laid for the Hamburg American Line.

North German Lloyd Activities, Germany. It is reported that the North German Lloyd will increase its capital to 600,000,000 marks. The company now has under construction in the Schihau Yard at Danzig a 35,000-ton liner to be placed in the New York-Bremen service when completed, according to latest information. Plans for the company's rehabilitation of its position on the seas have been outlined, and according to Mr. Ehlers, an official of the line, the company now possesses the Vegesack and Bremerhaven, built last year, and both in the Brazilian service; the Westfalen, Holstein, Gotha, York and Gottingen, as well as the Hanover, repurchased from England.

Three Steamers Ordered by Japanese. The Japanese steamship firm, Tenge & Company, of which Kaiyosha Company, 5 Canton Road, Shanghai, are agents, have placed orders with the Kiangnan and Mitsubishi Docks for the construction of three steamers. The steamers are expected to be launched in March and immediately put into service on the upper Yantze on the Ichang Chungking run. The vessels will be of uniform size, each 205 feet long, 31 feet beam, and 17 feet deep.

Pier, Hongkong, China.—Bids are being asked for the construction of a reinforced concrete pier, 160 feet 8 inches long by 41 feet 4 inches wide, and approach at Queen's Stature Square.

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STEAMSHIP INTERESTS—(Continued)

Danzig has been put into effect by steam ship companies at Montreal. Westbound rates from those ports were lowered $1.00 more. The International Mercantile Marine Company recently announced a reduction of 20 per cent in third class passenger rates to European ports. Most of the transatlantic steamship lines operating to continental ports will make a cut in their third class passenger rates, it is reported, the cuts amounting to from $20 to $40. The regular 10 per cent winter reduction in the first and second class passenger rates is now in effect.

BUSINESS NOTES

The firm of Rossell and Thayer has been given exclusive rights for the Philadelphia district by the McNab Company, Bridgeport, Conn., to sell their specialties, with Trenton and Wilmington as the northern and southern limits. In addition to their line of engine direction indicators, logometers and instruments of that character, and their salt detector, boiler circulator, loading draft gauge, the McNab-Vickers lubricated stern tube and the McNab-Kitsell hose couplings, they hold the United States rights for many other marine specialties. Rossell and Thayer have also been given the same territory by the Diamond Power Specialty Company, for the marine field, to sell the Diamond soot blower.

Consolidating the Small Tool and Drill Divisions, the Greenfield Tap & Die Corporation of Greenfield, Mass., has placed P. T. Irvin, formerly manager of their Drill Division, in charge of the consolidation, which will be called the Small Tool Division. Mr. Irvin has for the past three years been sales manager of the Lincoln Twist Drill Company, and prior to that was sales manager of Wells Brothers Company, of Greenfield.

The Atlas Valve Company, manufacturers of reducing valves, pump governors, and regulating devices, are now represented in the cities of Chicago and Detroit, through the offices of the Maher Engineering Company. The Detroit office is located at 744 David Whitney building and the Chicago office at 30 North Michigan Boulevard, in charge of Mr. E. E. Maher.

The Whiting Corporation, Harvey, Ill., has purchased a controlling interest in the Grindle Fuel Equipment Company, manufacturers of complete powdered coal plants for use in connection with malleable furnaces, annealing ovens, steam boilers, billet heating and various other types of furnaces. The Grindle Fuel Equipment Company has moved its offices to Harvey, and will continue its business under the same name. The Whiting Corporation will manufacture all Grindle equipment.

The firm name of Struthers & Barry has replaced the name of Struthers & Dixon, of San Francisco, due to the fact that Fred M. Barry has become a partner in the firm, replacing Captain Andrew Dixon, who retired some months ago.

David G. Reid, Inc., ship brokers, have removed their offices to 12 Broadway, New York.

The Thorndyke-Trenholme Company, a Pacific Coast shipping and chartering firm, has opened a branch office at 17 State street, New York, in charge of Emerson J. Griffith, eastern manager. The company's headquarters are in Seattle. Mr. Griffith was formerly assistant to the vice-president and general manager of the Admiral Line in Seattle.

TRADE PUBLICATIONS

Achievement in Motorships—The McIntosh and Seymour Corporation has issued a catalogue outlining the development of the present Diesel engine designs being produced in the plant at Auburn, N. Y. The American rights for this engine with certain modifications were obtained in 1913 from the Aktiebolaget Diesels Motorer of Stockholm, Sweden. The experience and facilities of this company for engine work are the result of twenty-one years service. Details of the fabricating of the engines in the shops, their installation and operation in motorships are described and illustrated, comparative diagrams and charts are also shown giving the economies possible with motor driven vessels.

Valves—Types of valves and asbestos packed cocks for every manner of marine and stationary service are illustrated and the specifications and uses outlined in a book issued by the Pratt & Cady Company, Inc., Hartford, Conn. This catalogue supersedes all previous issues and the terms, discounts, prices, guarantees and the shipment allowances mentioned are correct to date.

Normand Diesel Motors—A unique method of presenting information on Diesel motor products by a foreign firm is embodied in a catalogue which has been received from the Chantiers et Ateliers Augustin Normand, Le Havre, France, in which transparent insert pages give the English translation of the original French details of Normand Diesel engines. A history, well illustrated with views of the plant is given of the Normand Works, together with lists of ships fitted with Normand engines. The book also contains a complete treatise of the theory, design and manufacture of the various parts of the engines. Seven plates are bound in the catalogue giving plans and arrangements of engines and ships up to 7,200 tons deadweight capacity. The engines for these ships range from 500 to 1,350 horsepower, the 7,200-ton cargo ship having two of this latter power for her propelling unit.

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AMERICAN STEAMSHIP OWNERS' ASSOCIATION
11 Broadway, New York
Vice-President and General Manager—Winthrop L. Marvin.

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149 Broadway, New York
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39 Elmbank Crescent, Glasgow.

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